BRITISH COLUMBIA

NEWS RELEASE

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2005HEALTH0043-001143
Dec. 8, 2005

Ministry of Health

REPORT SHOWS IMPACT OF DIABETES IN B.C.

VANCOUVER – Action by governments, communities, health-care providers and individuals is needed to stop the increase of diabetes, particularly type 2, announced provincial health officer Dr. Perry Kendall as he released his 2004 annual report.

"Type 2 diabetes accounts for 90 per cent of diagnosed diabetes cases in B.C. This type of diabetes is closely linked to obesity, making it largely preventable," said Kendall. "By being physically active, eating healthier foods and quitting smoking, people can reduce their risk of developing this permanent chronic condition, or control it when it does occur."

Diabetes happens when the body lacks or makes inefficient use of the pancreatic hormone insulin, resulting in the inability of cells to convert glucose to energy. The three main types of diabetes are type 1, type 2 and gestational diabetes. Type 2 is mostly diagnosed in people over the age of 40 who are overweight or obese. People with diabetes are at a higher risk of early death due to direct complications or related conditions such as cardiovascular disease and chronic renal disease. In 2003/04, patients diagnosed with diabetes accounted for over 20 per cent of all deaths in B.C.

Last year, almost 220,000 British Columbians were living with diabetes, with that number expected to rise to 390,000 in the next 10 years. The direct costs for diabetes to B.C.'s health system, including hospitalization, medical services plan and PharmaCare, were about $1.04 billion in 2003/04. These costs could increase to $1.9 billion in the next 10 years if the prevalence continues to rise at the current rate. However, if prevention initiatives can reduce the incidence of diabetes by just 25 per cent, an annual savings of $200 million could be realized within 10 years.

"Governments and communities need to work together on long-term strategies and funding for prevention to provide individuals with the tools to combat this lifelong disease," said Kendall. "Diabetes prevention and better management can improve the lives of people living with the disease and, at the same time, ease cost pressures on the entire health system and benefit the whole province."

The report contains nine recommendations for government, including:

- Developing a system to monitor the health impact of diabetes on the population, study risk factors, track treatment and monitor incidence of diabetes-related complications, and evaluate programs.
- Creating primary health teams to enable better management of diabetes and prevent complications and other chronic disease conditions.
- Educating the public and increasing awareness about diabetes and its risk factors.
- Increasing funding for diabetes-related fields, programs and community-based prevention strategies.
- Adding resources for programs such as ActNow BC, to help promote their success and delivery over the long term.

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- Ensuring social assistance and low-income supports are tied to the cost of a healthy diet to help lessen associations with low-income, food insecurity and chronic disease.
- Monitoring and regulating marketing approaches adopted by the food industry. Marketing of foods high in fat, sugar or starch could be contributing to the rising rates of obesity in the province.
- Reviewing the option of extending PharmaCare coverage for glucose-monitoring devices and other equipment.
- Ensuring policy makers are aware of the incidence and prevalence of diabetes and the projected economic impact, so effective policies and recommendations for its prevention are implemented.

The data and statistics in the report are being published for the first time in British Columbia, and outline prevalence, incidence, mortality and associated health system costs. The information is based on the National Diabetes Surveillance System, a collaborative effort by federal, provincial and territorial jurisdictions to track the incidence and prevalence of diabetes in Canada.

Find more information in the provincial health officer's annual report 2004 at www.healthservices.gov.bc.ca/pho/.

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1 backgrounder(s) attached.

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BRITISH COLUMBIA

BACKGROUNDER

2005HEALTH0043-001143
Dec. 8, 2005

Ministry of Health

HELP FOR DIABETES IN BRITISH COLUMBIA

The B.C. government provides a number of tools, services and programs to help people prevent and manage diabetes:

- The Chronic Disease Self-Management Program is an educational program offered in communities throughout the province that gives patients the confidence and motivation they need to manage the challenges of living with a chronic condition, such as diabetes.
  Website: www.healthservices.gov.bc.ca/cdm/patients/diabetes/index.html

- Across B.C., the Ministry of Health funds 80 diabetes education centres. These centres are staffed by health-care professionals, and provide support and information on healthy eating, safe use of medications and ways to prevent complications from the disease.
  Website: www.healthservices.gov.bc.ca/cdm/patients/diabetes/dec.html

- Each regional health authority has its own Aboriginal health plan, to enhance First Nations' health within the region, which includes addressing priority issues such as diabetes. .

- ActNow BC, a collaborative, cross-ministry and inter-sectoral initiative to help B.C. lead the way in North America in healthy living and physical activity. Programs under ActNow BC that can assist with the prevention and control of diabetes include:
  - Nutrition and physical activity programs and services, including Community Food Action Initiative and Active Communities.
  - Action Schools! BC provides children in schools with greater opportunities to be physically active.
  - The School Fruit and Vegetable Snack Program pilot study, which provides one serving of B.C. grown fruits or vegetables twice a week to children at 10 elementary schools in the province.
  - Tobacco use reduction through quitnow.ca, an online resource to help people quit smoking, and tobaccofacts.org, a youth and teacher oriented web-based prevention resource outlining the impacts of tobacco use and alternatives for healthy living.

The ActNow BC website can be found on the main government site at www.gov.bc.ca.

- Through the Healthy Schools Initiative, the B.C. government has made a commitment to promote healthy foods, and eliminate unhealthy foods and beverages in B.C. schools by 2009. The Ministry of Education recently released food guidelines to help B.C. schools meet this goal.
- Dial-A-Dietitian is a free nutrition information line available to all British Columbians, which provides basic nutrition consultation, referrals to hospital outpatient dietitians, community nutritionists or other nutrition services for more in-depth information. Translation services are available in 130 languages.
  Website: www.dialadietitian.org/

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The Impact of Diabetes

on the Health and Well-being of People in British Columbia

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The Impact of Diabetes

on the Health and Well-Being of People in British Columbia

BRITISH COLUMBIA
Ministry of Health
Office of the
Provincial Health Officer

Provincial Health Officer's
Annual Report 2004

Ministry of Health

Victoria, BC

December 8th, 2005

The Honourable George Abbott

Minister of Health

Sir:

I have the honour of submitting the Provincial Health Officer's Annual Report for 2004.

P.R.W. Kendall, MBBS, MSc, FRCPC

Provincial Health Officer

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Highlights

Diabetes is a chronic condition that results from a deficiency or ineffective use of insulin in the body. Insulin is a hormone produced in the pancreas that helps the cells to absorb glucose. If insulin is not produced or used efficiently in the body, the cells will not be able to absorb glucose from the bloodstream. High levels of glucose can result in damage to the organs such as kidneys, eyes, nerves and blood vessels, leading to serious illness and possible death.

In general, there are three types of diabetes: Type 1, Type 2 and gestational diabetes. Type 1 diabetes occurs when the pancreas does not produce the insulin that is needed for the body to convert glucose to energy. Type 2 diabetes occurs when the pancreas does not produce enough insulin or when the body is not able to use the insulin that is produced. Gestational diabetes is a temporary condition that occurs during pregnancy; however, women who develop gestational diabetes may be at an increased risk of developing Type 2 diabetes. Over 90 per cent of diagnosed cases of diabetes are Type 2 diabetes, which typically occurs in adults who are also overweight or obese. Research has shown that factors such as unhealthy eating and physical inactivity play a major role in the onset of Type 2 diabetes.

Today, diabetes is considered to be one of the more prevalent of all chronic diseases worldwide. The prevalence of diabetes is increasing in British Columbia. In 2004, approximately 220,000 individuals – 5.2 per cent of the population – were living with diabetes in British Columbia. Each year, approximately 20,000 British Columbians are diagnosed with diabetes and it is estimated that 4 out of 10 people with diabetes will develop complications such as blindness, kidney disease, cardiovascular disease, amputations, and reduced life expectancy (McParland, 2002). Mortality rates among people with diabetes are more than twice as high as those who do not have diabetes. Over 6,000 individuals with previously diagnosed diabetes died in 2003/2004, accounting for over 20 per cent of all deaths in the province. The majority of these deaths were caused by diseases of the circulatory system and malignant neoplasms (cancers) that are associated with complications of diabetes.

The prevalence of diabetes among the First Nations population in Canada has increased significantly in the last 50 years (Health Canada, 2000). The combination of the non-traditional diet high in carbohydrates, simple sugars, and fats, and a sedentary, inactive lifestyle has more than likely contributed to the epidemic of diabetes among the First Nations population. At the end of the fiscal year 2003/2004, there were an estimated 5,600 Status Indians living with diabetes in British Columbia. The prevalence of diabetes in the Status Indian population is higher among females and the younger population compared to other BC residents. The Status Indian population with diabetes have mortality rates that are about two times higher than those without diabetes, and on average, each year, more than 100 Status Indians with diabetes die in British Columbia.

In 2003/2004, people with diabetes and its complications accounted for 19 per cent of all hospital costs, 14 per cent of Medical Services Plan costs and 27 per cent of PharmaCare costs. If the current trends continue, the approximately $1.04 billion in costs in 2003/2004 for hospitalization, Medical Services Plan, and PharmaCare costs for persons with diabetes will rise to approximately $1.90 billion by 2015/2016—an increase of $900 million (just over 80 per cent). However, if prevention methods are employed and the incidence of diabetes is reduced by 25 per cent, $200 million in costs could be averted annually within 10 years.

Research has consistently shown that Type 2 diabetes is preventable. Prevention of Type 2 diabetes is categorized as primary (actions to prevent the development of diabetes), secondary (early diagnosis and retarding the progress of diabetes) and tertiary (minimizing the effects of diabetes by prevention and management of its complications).

In general, there are two approaches to primary prevention of Type 2 diabetes: the high-risk approach and the population-based approach. The high-risk approach focuses on individuals at high risk of developing diabetes, while the population-based approach focuses on the whole population.

The high-risk approach to primary prevention of diabetes focuses on individuals who are most at risk of developing diabetes. These individuals are generally at the Impaired Glucose Tolerance (IGT) stage, which is characterized by insulin resistance and the impairment of insulin secretion, and also have other risk factors such as obesity, physical inactivity, smoking, high blood pressure, family history, and genetic factors. The high-risk approach focuses on dietary changes, weight reduction, and increased physical activity for these individuals. Many studies have proven that a combination of dietary changes and increased physical activity will delay the development of diabetes or in some cases prevent diabetes.

The population-based approach focuses on prevention strategies for the whole population. These interventions introduce strategies that change the environment in which people work and live to make the healthy choice the easy choice. The most important element of a population-based approach is the integration of communities, workplaces, schools, and social and health care settings to provide a supportive environment and access to healthier choices, which will in turn reduce the burden of chronic diseases such as diabetes. Research has shown that effective population-based interventions are generally multi-faceted, allow participants a significant degree of control and are planned and resourced over a long period (International Union for Health Promotion and Education, 2000).

Population health promotion and disease prevention strategies that have proven to be successful have the following combined elements:

- **Market regulation** – Regulation and restriction through fiscal policy.
- **Interventions by primary health care providers** – Support and care of a professional health care team with a multi-faceted and dynamic approach that is efficient and cost-effective.
- **Education and public information intervention** – Effective education and public information that contributes to a change in individual behaviour.
- **Socio-environmental interventions** – Public policies such as issues related to smoke-free work and public places and other health and social policy initiatives.
- **School-based intervention** – Well-designed school prevention strategies and programs that are known to be effective for children and that persist well into their adulthood.
- **Workplace interventions** – Programs and policies that encourage behavioural change and create safer and healthier work environments.
- **Community support** – Community-based and community-wide approaches that have been proven to hold the greatest promise in health promotion (International Union for Health Promotion and Education, 2000).

The Ministry of Health has launched prevention and wellness initiatives with a population-based focus. Examples of these initiatives include Action Schools! BC, ActNow BC, the Chronic Disease Framework, and the BC Nutrition Survey. The majority of these programs focus on healthy eating, increasing physical activity, decreasing tobacco use, and decreasing overweight and obesity.

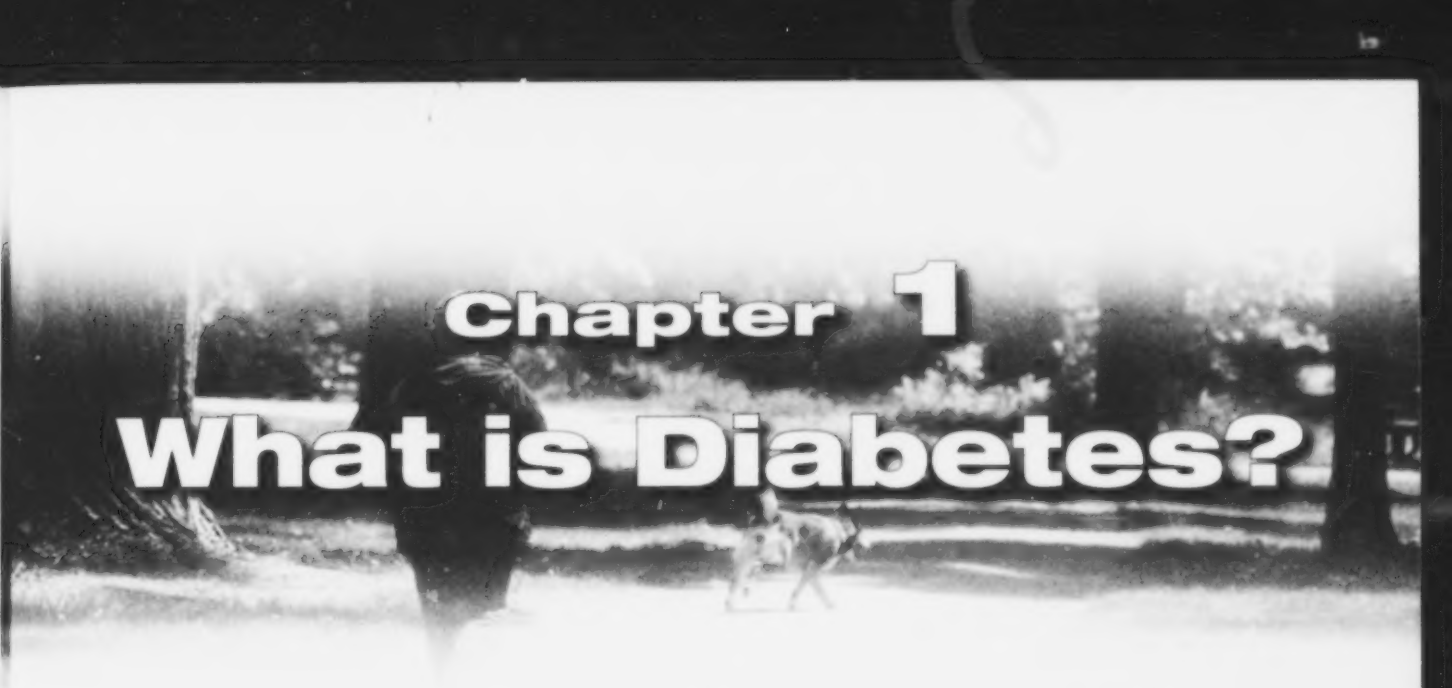
Secondary prevention involves early diagnosis of Type 2 diabetes and retarding the progress of the disease. Factors such as cost-effective methods of screening and treatment as well as appropriate resources to deliver both screening and treatment should be reviewed in providing secondary prevention. In general, targeted screening for Type 2 diabetes among individuals with possible risk factors is recommended.

Diabetes management (sometimes called tertiary prevention) entails prevention and management of the complications from Type 2 diabetes. Once an individual is diagnosed with diabetes, the treatment should focus on reducing blood glucose levels towards normal range to reduce the risk of microvascular complications (kidney disease, eye disease, and amputation). Research in managing diabetes has shown that exercise and restriction of food intake can improve glucose tolerance and decrease insulin resistance in many patients with established Type 2 diabetes.

The Chronic Disease Management Program of the BC Ministry of Health, in cooperation with the BC Medical Association, have established guidelines for proper management of diabetes. These guidelines specify several recommended services for diabetes patients that include control of glycemia (blood sugar), control of blood pressure and lipids (fats), and early detection and treatment of eye problems, damage to the kidneys, and foot disorders. In addition, the Chronic Disease Management Program has established initiatives such as the Diabetes Collaborative, the Patient Registry and Recall System, the Chronic Disease Self-Management Program, and the Chronic Care Practice Enhancement Incentive Project. Evaluation of data in BC clearly shows that with the exception of lipid testing, more than half of those with diabetes are not receiving the recommended clinical management interventions. To successfully manage diabetes, these programs need to be expanded with long-term committed resources and funding, and be provided to all diabetes patients in the province.

Responsibility for addressing the growing burden of diabetes rests with all partners and stakeholders. Success requires a sustained effort to collaborate, integrate, and innovate on a comprehensive range of initiatives. Prevention and management of diabetes should involve a reorganization of the way primary care is delivered in the province. The new vision of primary care should involve a health care team supported by an efficient patient registry system that has a goal of improving health through prevention and care programs. The health care team could involve doctors, nurses, dietitians, physiotherapists, pharmacists, social workers, counsellors, and other health care professionals..

For prevention programs to be successful, governments and communities need to work together to provide effective, aligned, multi-sectoral strategies as well as committed resources and funds to maintain programs for a long period of time. It is important to note that prevention and management of diabetes is a collective responsibility of all partners and stakeholders in government and industries; a reduction in the human and financial burden of all forms of diabetes and its complications can be achieved through creation of healthier communities, supportive environments, and cost-effective and efficient health care services. This approach will enable effective self-care and enhanced quality of life for those affected by diabetes in British Columbia. In addition, it will also result in a reduction of the incidence and improved management of diabetes and other chronic diseases.



Chapter 1
What is Diabetes?

Diabetes is a chronic condition that results from the body's inability to sufficiently produce or use insulin—a hormone produced by the cells in the pancreas that regulates the storage and use of glucose in the body.

All cells in the human body need energy in order to function. The primary energy source for the cells is glucose, a simple sugar resulting from the digestion of foods containing carbohydrates. Glucose is released in the bloodstream, ready for use by the body's cells. The pancreas, the organ located behind the stomach, is responsible for producing insulin. Insulin helps the cells to absorb glucose. When there is not enough insulin produced or when the cell's doorway is blocked, glucose stays in the blood, rather than entering the cells.

The body will attempt to excrete the excess glucose in the blood. This accounts for the symptoms of frequent urination and thirst in people with diabetes. In addition, since the cells are not receiving enough glucose, they send signals to the brain for more food and therefore the person becomes hungry. To provide the energy for the starving cells, the body keeps converting fats and proteins into glucose. The excess breakdown of the fats and proteins produces acid compounds called ketones to form in the blood. As ketones increase, a condition called ketoacidosis can occur, which can cause coma and death if left untreated. High glucose levels in the blood over a long period of time can result in damage to various organs including kidneys, nerves, eyes, heart, and blood vessels. Complications in these organs can lead to blindness, heart disease, kidney failure, and amputations (Dr. Joseph F. Smith Medical Library, 2005).

Types of Diabetes

Of the many types of diabetes, the three main ones are: Type 1, Type 2, and gestational diabetes.

Type 1 Diabetes

Type 1 diabetes, sometimes described as insulin-dependant diabetes, occurs mostly in children or adolescents. In Type 1 diabetes, the immune system attacks the insulin-producing cells in the pancreas and destroys them. As a result, little or no insulin is produced in the body. Individuals with Type 1 diabetes need daily injections of insulin to control their blood glucose. Scientists still do not know why the body's immune system attacks the cells in the pancreas; however, they believe genetic factors or viruses may be involved. Symptoms of Type 1 diabetes include thirst, frequent urination, constant hunger, weight loss, blurred vision, and fatigue. If this condition is not diagnosed and treated with insulin, patients could lapse into coma and could die (Health Canada, Centre for Chronic Disease Prevention and Control [CCDPC], 2002).

Type 2 Diabetes

Type 2 diabetes is the most common type of diabetes and accounts for more than 90 per cent of the diagnosed diabetes cases. Type 2 diabetes typically occurs in people over 40 who are overweight or obese. Most individuals with Type 2 diabetes are insulin resistant[1]; however, by losing weight, exercising, and taking oral medication, it is possible to overcome this resistance. Type 2 diabetes can present itself with no symptoms; however, the general symptoms may include feeling tired and sick, frequent urination, excessive thirst, excessive hunger, and weight loss. Type 2 diabetes can also lead to a number of diseases such as cardiovascular disease (heart diseases) and microvascular diseases (kidney failure, blindness, etc.) (Health Canada, CCDPC, 2002).

Gestational Diabetes

Gestational diabetes occurs in some pregnant women and in most cases ends after birth. More than 40 per cent of women with gestational diabetes may develop Type 2 diabetes when they get older. Gestational diabetes must be treated with diet and/or insulin since the condition might affect both the baby and the mother. This condition can be managed by screening, patient education, control of blood sugar, and perinatal monitoring (Health Canada, CCDPC, 2002).

Diagnosis of Diabetes

Medical tests can be used to confirm a diagnosis of diabetes based on the amount of glucose present in the urine and blood. These tests can also be used to monitor the disease after the patient has been diagnosed and put on a standardized diet, oral medication, or insulin (Health Canada, CCDPC, 2002). In 1998, the diagnosis threshold for diabetes was changed from 7.8 mmol/L to 7.0 mmol/L based on the evidence of development of microvascular complications associated with diabetes (Harris, Meltzer, & Zinman, 1998).

It is therefore possible that the new lower cutoff value of 7.0 mmol/L has contributed to the identification of more diabetes cases, and hence the increasing prevalence of diabetes.

Diabetes in Canada

Today, it is estimated that approximately 2 million Canadians have diabetes, and approximately 40 per cent of these cases will develop complications. Factors that can lead to obesity, such as lack of physical activity and unhealthy eating habits, play a major role in the onset of Type 2 diabetes. Type 2 diabetes rates are significantly higher in the First Nations population than in the general population (Health Canada, Information Kit, 2003).

In 1999, the federal government announced a five-year plan and pledged $115 million to help prevent and control diabetes. The Canadian Diabetes Strategy includes four components: Prevention and Promotion, the First Nations Diabetes Initiative, the National Diabetes Surveillance System (NDSS) and National Coordination. Based on the significantly higher rates of diabetes among First Nations people, the Aboriginal Diabetes Initiative recognizes the need for funding to provide care and treatment of diabetes for those living on or off-reserve and also to support prevention and health promotion activities for First Nations people in Canada. In 2005, an additional $90 million was devoted to the renewal and enhancement of the Canadian Diabetes Strategy.

The main goal of the NDSS is to develop, facilitate, and coordinate diabetes surveillance on the national, provincial, and territorial levels, and among First Nations communities. This will involve the production of nationally comparable data on diabetes prevalence and incidence, as well as comparisons of mortality, diabetes-associated diseases, and health care utilization rates in populations with diabetes compared to populations without diabetes (Health Canada, National Diabetes Surveillance Strategy, 2003).

[1] *Although insulin can attach normally to receptors on liver and muscle cells, certain mechanisms prevent insulin from moving glucose into these cells where it can be used. This condition is known as insulin resistance (Health Canada, CCDPC, 2002, pp.20-21.)*

Diabetes in British Columbia

The prevalence of diabetes is increasing in British Columbia. In 2003/2004, approximately 220,000 British Columbians —5.2 per cent of the population—were living with diabetes. Approximately 20,000 individuals are diagnosed with diabetes every year in British Columbia. It is estimated that without any prevention measures, over 390,000 British Columbians will have diabetes by the end of fiscal year 2015/2016; this represents an increase of 77 per cent in 10 years.

Contents of this Report

The 2004 Provincial Health Officer's Annual Report intends to inform British Columbians of the status of diabetes in the province. This report will provide an overall analysis of the number of people living with diabetes (prevalence), those who are diagnosed with diabetes (incidence), and mortality from diabetes for the general population as well as the First Nations population (specifically, Status Indians)[1] in British Columbia. The report will also include information on the cost of diabetes as well as prevention and management of diabetes. The last chapter of the report will focus on recommendations for improvements in prevention and management of diabetes in British Columbia.

This report has been designed with a variety of interests in mind. Those who are interested in a quick overview could refer to the Highlights Chapter, the individual quotations in Chapters 2, 3, and 4 the summary sections at the end of Chapters 2 to 5, and the Recommendations Chapter. For those who are interested in detailed data analysis, data tables and figures are provided throughout this report. The Appendices at the end of the report provide further details on data sources and definitions, methods and calculations, formulas used for calculations, and detailed regional data.

Auditor General's Report

In October 2004, the Auditor General of British Columbia released his report on *Preventing and Managing Diabetes in British Columbia*. This report discussed the status of diabetes in British Columbia, and recommended strategies to improve the prevention and management of diabetes in the province. We will refer to the findings and recommendations of the Auditor General in Chapter 4 of this report.

Provincial Health Officer's Reports

Since 1993, the Provincial Health Officer has been required by the *Health Act* to report annually to British Columbians on their health status and on the need for policies and programs that will improve their health. Some of the reports produced to date have given a broad overview of health status, while others have focused on particular topics such as air quality, drinking water quality, immunization, injection drug use, First Nations health, injury prevention, and school health. Reports by the Provincial Health Officer are one means for reporting on progress toward the provincial health goals, which were adopted by the province in 1997.

Copies of the Provincial Health Officer's report are available free of charge from the Office of the Provincial Health Officer by calling (250) 952-1330, or electronically (in a PDF file) from: http://www.healthservices.gov.bc.ca/pho/

[1] *Note that the First Nations diabetes section in this report is based on data produced for the entire BC population. A separate initiative of the First Nations component of the National Diabetes Surveillance System will be publishing more detailed information specifically for First Nations people in British Columbia.*

Frederic Banting: Diabetes and the Discovery of Insulin

Frederick Grant Banting was born on November 14, 1891, near Alliston, Ontario. Upon finishing high school, he attended the University of Toronto to study divinity but decided to transfer to medicine in the following year. With the start of World War I, Banting joined the Canadian Army and served in Britain and France. After the war ended, he returned to Toronto and then moved to London, Ontario, where he set up his private practice. Banting's practice was not very successful, so he began teaching part-time at the University of Western Ontario in the departments of orthopedics and pharmacology. (Bliss, 1996)

In October 1920, while preparing for a lecture on the pancreas, Banting came upon earlier experiments which showed that when pancreatic ducts were closed by ligature (tying), some cells would degenerate but the islets of Langerhans (cells in the pancreas that produce hormones for proper metabolism[3]) would remain intact. (Nobelprize.org, n.d.) Earlier works on diabetes showed that the disease was caused by lack of a hormone produced by the islets of Langerhans. It was discovered that this hormone (which came to be known as insulin) controls the metabolism of sugar and that lack of it would result in the accumulation of sugar in the blood and urine.

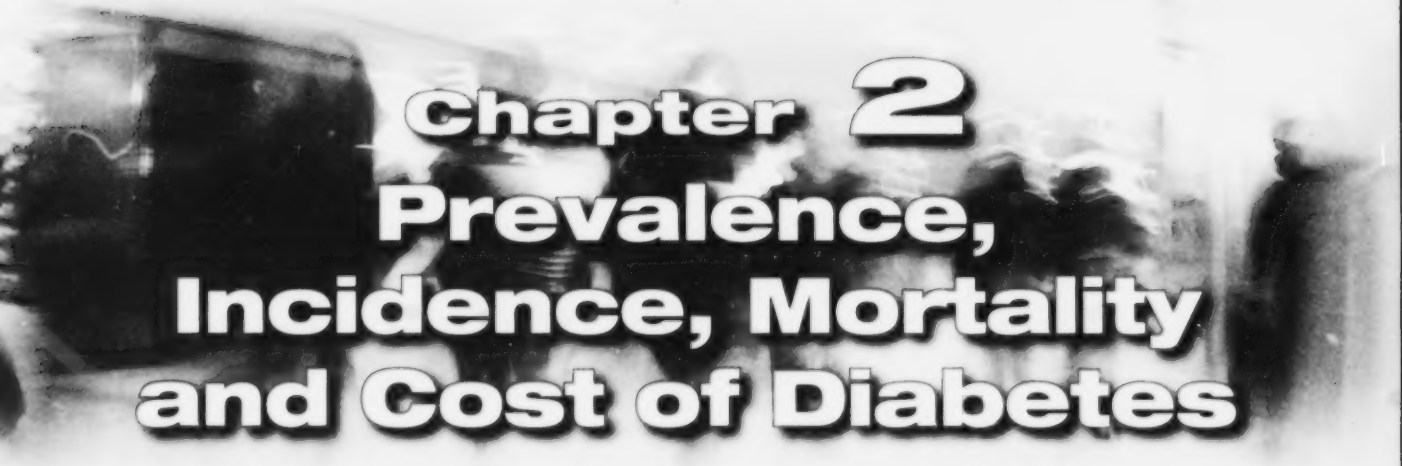
Banting's idea was to ligate the pancreatic ducts and wait six to eight weeks to successfully remove the extract. (Rosenfeld, 2002) Banting received support for his proposed research from the University of Toronto, and in May 1921, he began work under the direction of J.J.R. Macleod, with the assistance of a graduate medical student, Charles Best. Later, Bertram Collip, a biochemist who specialized in the purification of insulin, joined the research team. In 1922, after many trials and disappointments, they were able to achieve success with Leonard Thompson, who became the first patient to receive insulin. In February 1922, Banting and Best published their results of the administration of insulin in the Journal of Laboratory and Clinical Medicine. (Gerste, 2002)

In 1923, Banting and Macleod were announced as the recipients of the Nobel Prize in Medicine—the first recipients of such an award in Canada. Banting was furious that Best was not nominated and decided to share his award with him. Macleod soon followed suit and shared his award with Collip.

Banting received many awards and annuities from Parliament in 1923 and was knighted in 1934. He was also known as a talented painter and is said to have accompanied A.Y. Jackson (a member of the Group of Seven) on outings to sketch and paint. Jackson revealed that Banting was hoping to retire from medicine in his fifties and devote more time to his painting. Unfortunately, his life was cut short by a tragic warplane crash in 1941. He was in his 50th year.

To his colleagues, Banting was a determined man and to many he was a symbol of medical research. In a tribute to his colleague, Collip wrote: "Banting was a most unselfish individual. He was always mindful of helping others and it was almost a religion with him to encourage, stimulate and assist young research workers." (Rosenfeld, 2002)

[3] *These cells are named after Paul Langerhans, a German scientist who discovered them in 1869.*



Chapter 2 Prevalence, Incidence, Mortality and Cost of Diabetes

National Diabetes Surveillance System

In 1996, the concept for a National Diabetes Surveillance System (NDSS) was developed. The goal of the NDSS was to provide improved data on prevalence, incidence, and other aspects of diabetes. This was the first time a coordinated, national use of administrative data for public health surveillance purposes was undertaken.

This project is a partnership between the federal government, all provincial/territorial governments, non-governmental organizations, national Aboriginal groups, and researchers. The NDSS has improved the collection of data and has made it possible to measure prevalence, incidence, and mortality of diabetes, and diabetes-associated diseases for Canada as a whole, and for the provinces and territories.

Also for the first time, NDSS can compare health service use and other health outcomes of people with and without diabetes. The use of multiple databases in NDSS offers information on diabetes that is superior to what would be possible using one source alone. The resulting data can be used for surveillance as well as to answer research and policy questions. This is a great example of jurisdictions across Canada cooperating to achieve a shared goal of reducing the burden of diabetes (Health Canada, NDSS, 2003).

Methodology

The majority of the required data for this report were obtained from the administrative databases of the Ministry of Health, which contain hospital utilization, medical services utilization, prescribed drug utilization, and provincial health insurance coverage information.

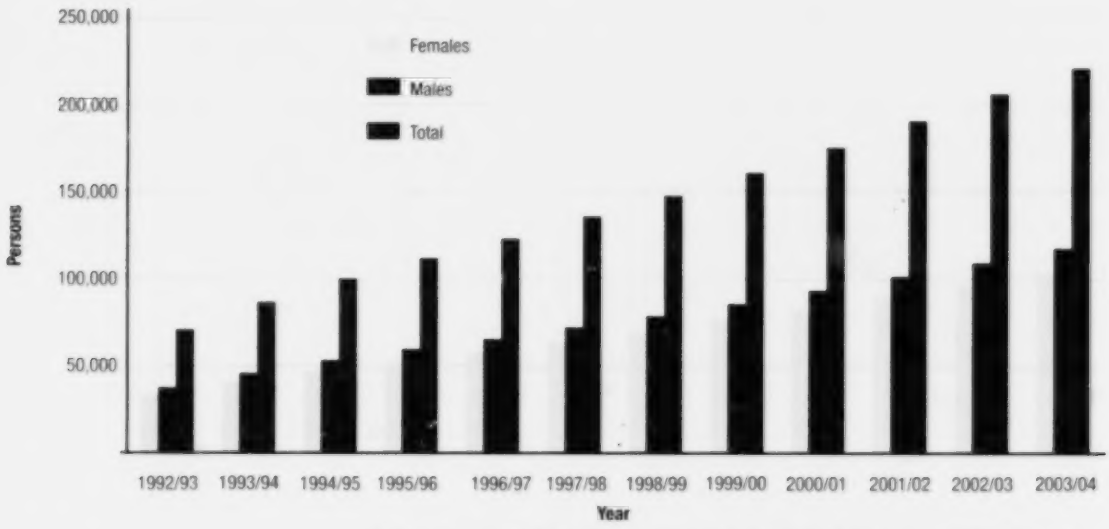
Although some of these databases contain diagnostic information, they are administrative in nature and cannot be considered clinical information systems with complete and accurate diagnostic and treatment information. As a result, the information derived from these databases provide an approximate picture of diabetes in the population. The measures calculated are used to identify general patterns of disease and utilization. General trends over time may also be apparent in the existing data. As more years of data become available, and as data quality improves, the picture of diabetes will become more complete and accurate. Many persons with diabetes may not yet have been diagnosed, or may yet remain undetected by the surveillance system.

Data Sources

The administrative data sources used for this report are the Physician Claims File, Hospital File, Health Insurance Registry, PharmaCare File, and Vital Statistics Mortality File. Because physician claims do not reliably distinguish between Type 1 and Type 2 diabetes, NDSS is not currently able to assess the level of Type 1 and Type 2 diabetes in the population. However, since over 90 per cent of the diabetes diagnosed is Type 2 diabetes, the data presented in this report relates mostly to those diagnosed with Type 2 diabetes. The majority of diabetes cases diagnosed for those under the age of 20 are Type 1 diabetes. Gestational diabetes cases are not included in the NDSS case definition. For a detailed description of the data sources, please consult Appendix C.

Prevalence of Diabetes in British Columbia

Figure 2.1 Prevalence of Diabetes, BC, 1992/1993 to 2003/2004*



*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of Medical Services Plan component of the incident case definition.

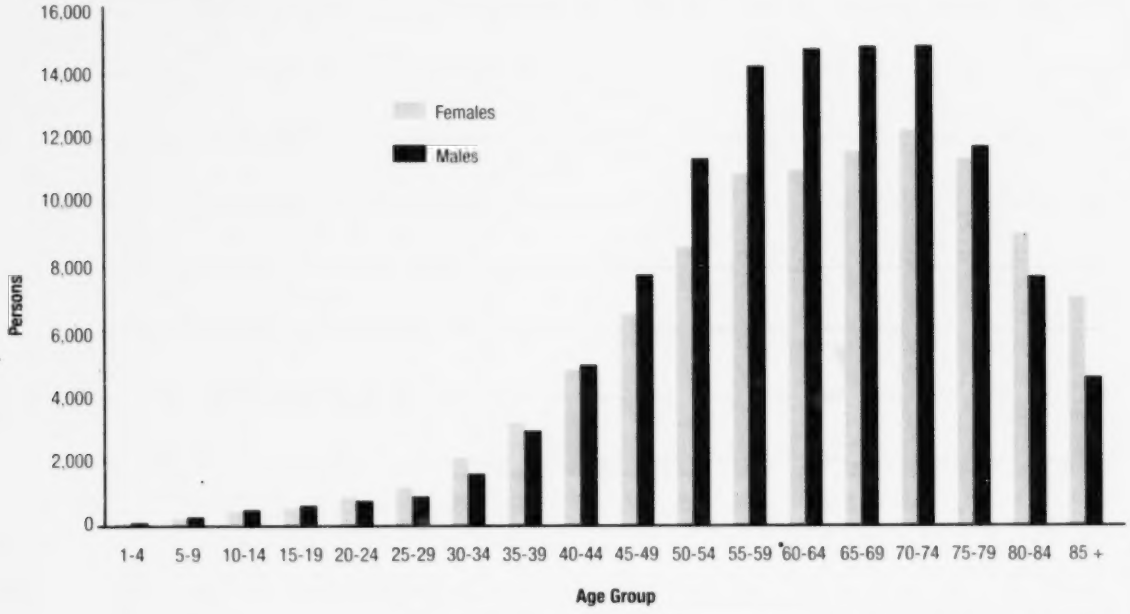
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"At the end of fiscal year 2003/2004, an estimated 220,000 people were living with diabetes in British Columbia."

The prevalence of diabetes is the number, or rate, of persons with diabetes in a population during a fiscal year. At the end of fiscal year 2003/2004, an estimated 220,000 people were living with diagnosed diabetes in British Columbia, a crude[1] prevalence of 5.2 per cent in the total population. Of this total, there were approximately 117,000 males (5.6 per cent) and 103,000 females (4.8 per cent) (Figure 2.1).[2] Although the number of persons living with diabetes continues to increase, there may be many more persons living with diabetes who are not yet diagnosed. For comparison, the Canadian Community Health Survey Cycle 2.1 estimates that 4.8 per cent (+/- 0.5 per cent) of the BC population self reported that they had been diagnosed with diabetes in 2002/2003. Males reported 5.6 per cent (+/-0.7 per cent) and females reported 3.8 per cent (+/-0.6 per cent) (Statistics Canada, 2004).

[1] *"crude" being that the rate was not standardized or adjusted for age.*
[2] *For the diabetes case definition, please refer to Appendix C.*

Figure 2.2 Age Distribution of Persons With Diabetes, BC, 2003/2004*



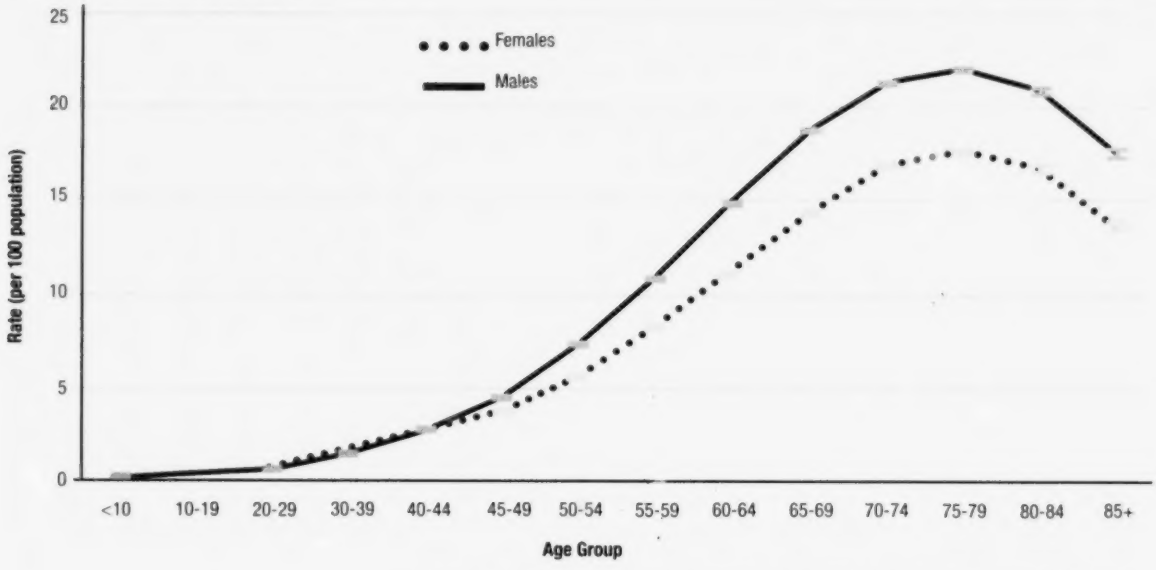
*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of Medical Services Plan component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"The number of those diagnosed with diabetes rises rapidly with age. In 2003/2004, males had the highest number of diabetes cases in the 65-69 age group while females had the highest number of cases in the 70-74 age group."

The number of persons living with diabetes rises rapidly with age for males and females, peaking in the 65-69 age group for males and 70-74 age group for females, and decreasing sharply thereafter (Figure 2.2). Males had higher numbers of cases in the age groups between 40 and 74 years of age, while female cases outnumbered males in the childbearing years and ages 75 and older. The increased proportion of female cases in the childbearing ages may reflect a small number of gestational diabetes cases that have been miscoded as Type 2 diabetes.

Figure 2.3a Age-Specific Prevalence Rate of Diabetes, BC, 2003/2004*



*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of Medical Services Plan component of the incident case definition.

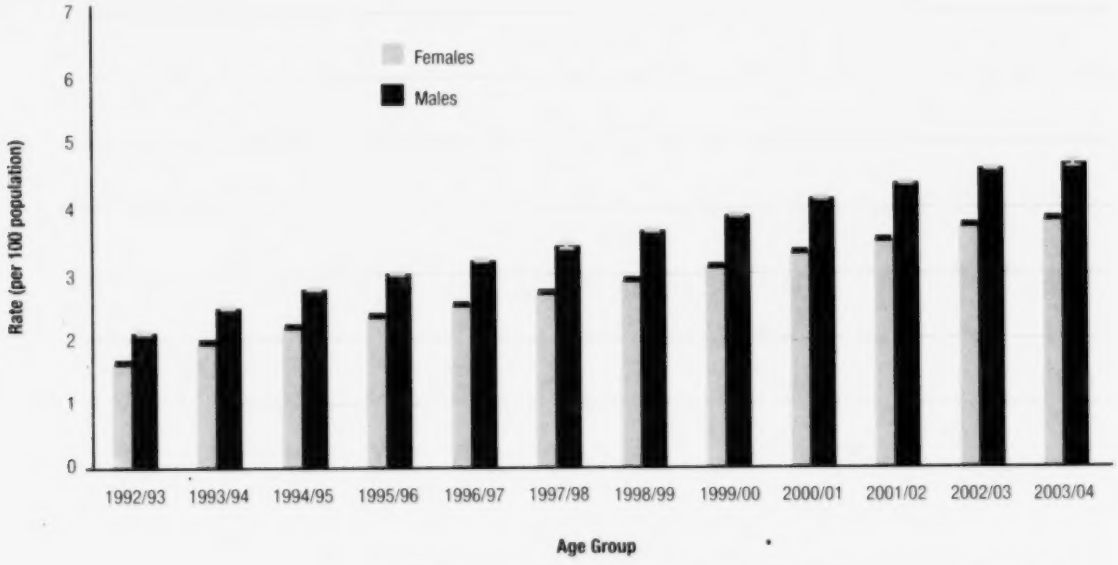
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"In 2003/2004, nearly 1 in 5 persons 75 years and older were living with diabetes in British Columbia."

Figure 2.3a shows the prevalence rate of diabetes by age group, with the associated 95 per cent confidence intervals (CI).[3] Prevalence increases with age, rising substantially after age 40 for both males and females. Male prevalence is significantly higher after ages 40-44 years. Female and male prevalence peaks at ages 75-79 years at about 17 per cent for females and 23 per cent for males. Nearly 1 in 5 persons 75 years and older were living with diagnosed diabetes in 2003/2004.

[3] *Confidence interval (CI) is described as the range of values within which a population parameter is estimated to lie. For a 95 per cent confidence interval, we expect the true value to be within the stated range 19 times out of 20. For example, if the prevalence rate in a population is stated as 5.2 per cent with a 95 per cent CI of 4.9 (lower) and 5.5 (upper), we would expect the true prevalence rate in the population to lie between 4.9 and 5.5 with only a 1 in 20 chance that it is not between these two values. Confidence intervals are represented by (I) on the figures throughout this report.*

Figure 2.3b Age-Standardized Prevalence Rate of Diabetes, BC, 1992/1993 to 2003/2004*



*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of Medical Services Plan component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

To compare overall rates for males and females, it is necessary to adjust for differences in the age structures of males and females (age-standardize – see Appendix C). The age-standardized prevalence rates for females and males were 3.8 per cent and 4.7 per cent respectively in 2003/2004 (Figure 2.3b).

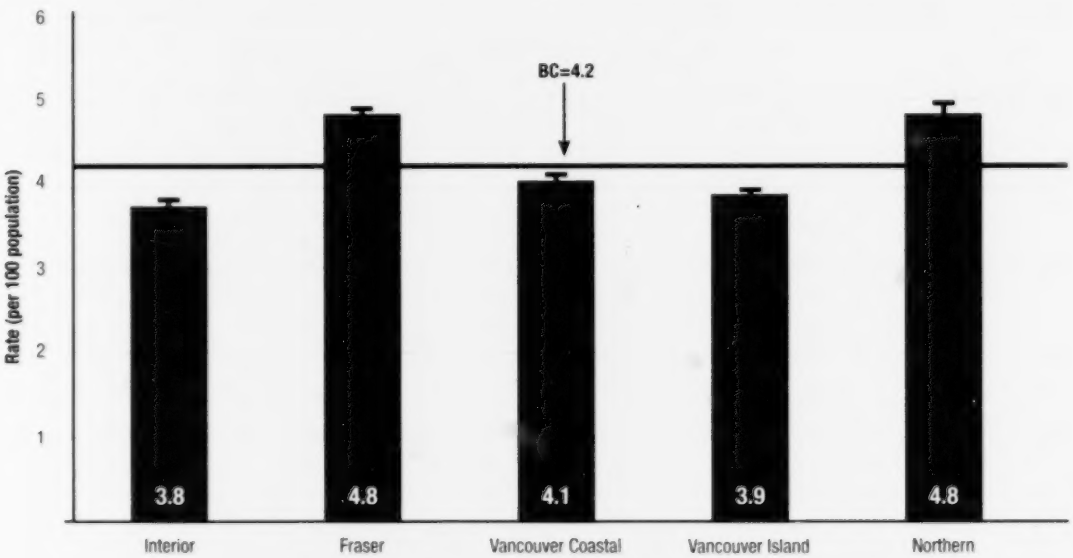
Table 2.1 **Distribution of Prevalent Diabetes Cases, by Health Authority, 2003/2004**

Health Authority	Crude Rate, Per cent	Prevalent Cases	Age-Standardized Rate, Per cent
Interior	5.3	36,000	3.8
Fraser	5.3	75,000	4.8
Vancouver Coastal	4.9	51,000	4.1
Vancouver Island	5.5	38,000	3.9
Northern	4.7	13,000	4.8
BC Adjusted*	5.2	220,000	4.2

Table 2.1 shows the numbers of cases and rates of diabetes by Health Authority across the province (see Appendix I for further regional data). Across the province, crude prevalence rates of diabetes range from a low of 4.7 per cent of the population in the Northern Health Authority to a high of 5.5 per cent in Vancouver Island Health Authority.

Fraser, Interior, and Vancouver Island Health Authorities have the greatest burden in terms of the percentage of the population with diabetes. This is expected in the Interior and Vancouver Island Health Authorities because of the older population structure in these areas. Fraser Health Authority has a younger population which indicates higher proportions of prevalent cases in younger age groups, similar to the Northern Health Authority.

Figure 2.4 **Age-Standardized Prevalence Rate of Diabetes, by Health Authority, 2003/2004***



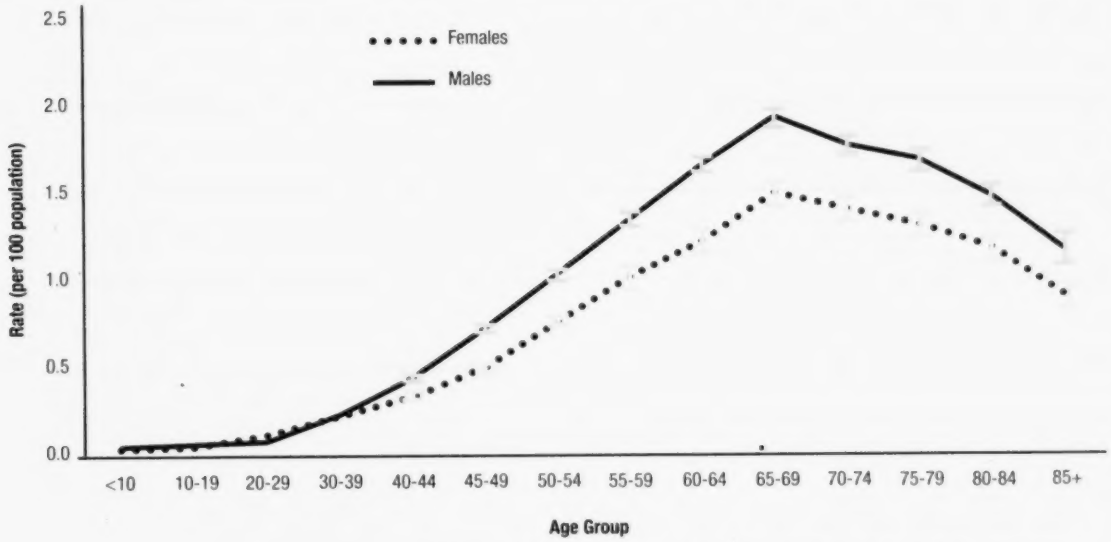
*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of Medical Services Plan component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

To adjust for differences in population age structure across Health Authorities, the rates are age-standardized to the 1991 Canada population. The age-standardized rate of diabetes prevalence varies from a low of 3.8 per cent in the Interior Health Authority to a high of 4.8 per cent in the Fraser and Northern Health Authorities. In the Fraser and Northern Health Authorities, the age-standardized rates are above the provincial rate of 4.2 per cent (Figure 2.4).

Incidence of Diabetes in British Columbia

Figure 2.5 Age-Specific Incidence Rate of Diabetes, BC, 1998/1999-2002/2003*



*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

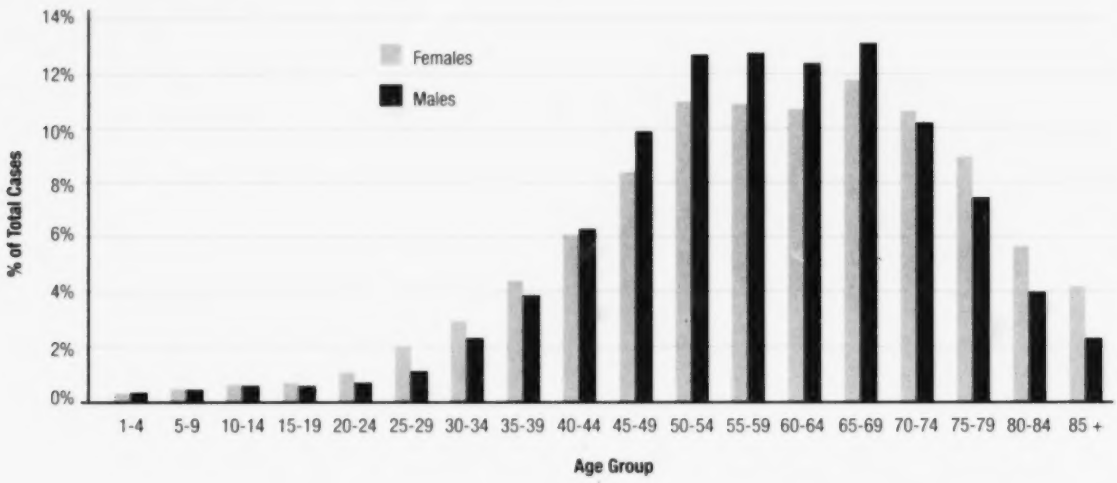
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"On average, about 20,000 new cases of diabetes are diagnosed every year in British Columbia."

The incidence of diabetes is the number, expressed as a rate, of persons first diagnosed with diabetes in a particular time period. Figure 2.5 shows age-specific incidence as a cumulative rate over the period 1998/1999-2002/2003. Because of incomplete follow-up (12-months of Medical Service Plan component of incident case definition) the year 2003/2004 is omitted from certain figures. Over this 5-year period, around 103,000 new cases of diabetes were identified—on average, about 20,000 new cases per year. Incidence rates rise sharply after ages 40-44 and peak at ages 65-69. Incidence rates for males exceed females from ages 40-44 and continue to be higher through 85+ years.

Figure 2.6

Percentage Distribution of Incident Cases of Diabetes, by Age Group, BC, 1998/1999-2002/2003*



*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"The patterns for incidence of diabetes differ among males and females. Males tend to have a greater proportion of cases in the 45-69 age groups while females tend to show a greater proportion of cases in the 70 and older age groups."

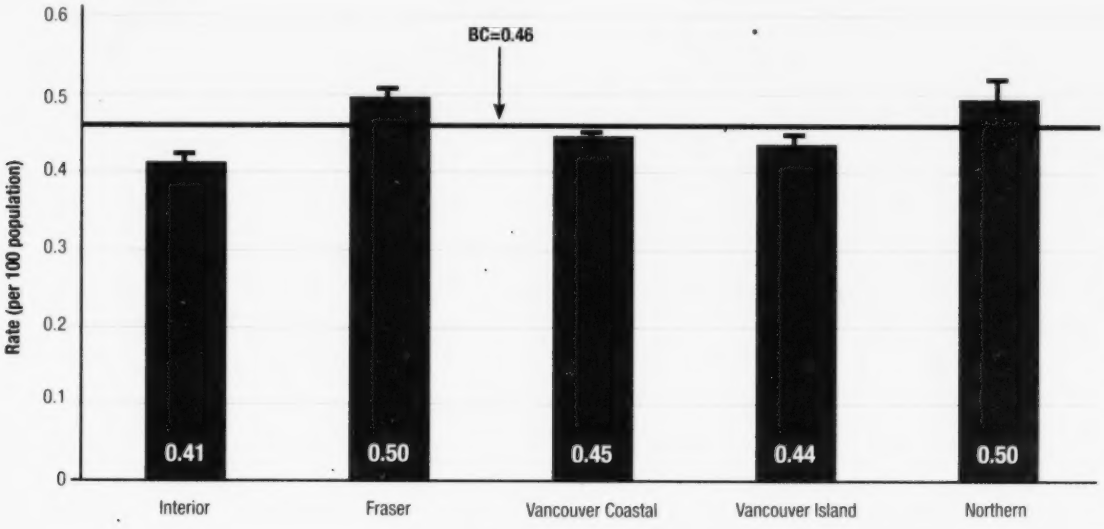
Figure 2.6 shows the percentage distribution of incident cases over the 5-year time period. The number of incident cases increases up to age 50-54 and then declines after ages 65-69. In the childbearing years, females have a greater proportion of incident cases and this may reflect a small number of miscoded gestational diabetes cases. Males tend to have a greater proportion of cases in the 45-69 age groups while females tend to show a greater proportion of cases in the 70 and older age groups.

Table 2.2 **Distribution of Incident Diabetes Cases, by Health Authority, 1998/1999-2002/2003**

Health Authority	Crude Rate, Per cent	Incident Cases	Age-Standardized Rate, Per cent
Interior	0.54	17,000	0.41
Fraser	0.54	35,000	0.50
Vancouver Coastal	0.53	24,000	0.45
Vancouver Island	0.57	18,500	0.44
Northern	0.47	6,000	0.50
BC	0.53	103,000	0.46

New cases of diabetes diagnosed in each Health Authority over the five-year period from 1998/1999 - 2002/2003 are shown in Table 2.2. Northern Health Authority experienced the lowest crude incidence rate of diabetes at 0.47 per cent. Vancouver Island Health Authority showed the highest crude incidence rate of diabetes at 0.57 per cent.

Figure 2.7 **Age-Standardized Incidence Rate of Diabetes, by Health Authority, 1998/1999-2002/2003***



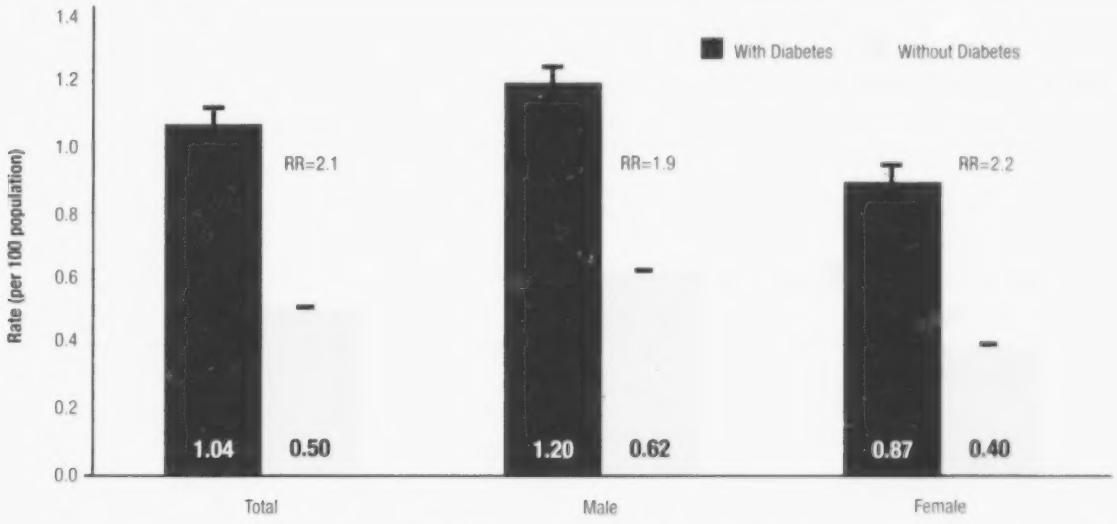
*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

To adjust for differences in the population age structure across Health Authorities and the resulting effect on rates, Figure 2.7 shows the age-standardized incidence rate of diabetes by Health Authority for a 5-year period from 1998/1999 to 2002/2003. The incidence rates vary from a low of 0.41 per cent in the Interior Health Authority to a high of 0.50 per cent in the Fraser and Northern Health Authorities, which is higher than the provincial average of 0.46 per cent.

Mortality and Diabetes in British Columbia

Figure 2.8 Age-Standardized Mortality Rates for Persons With and Without Diabetes, BC, 1998/1999-2002/2003*



*Note: Figure 2.8 and Table 2.4 present rate ratios based on different data over different time periods and using different age groupings for the underlying age-standardized mortality rates. As such, the rate ratios are only generally comparable. Figure 2.8 is using probabilistic linkage to overall death counts, age-standardized mortality rates, and rate ratios over a 5-year period (age-standardized using 14 age groups). Table 2.4 is using deterministic linkage to cause of death counts, age-standardized mortality rates and rate ratios over a 12-year period (age-standardized using three age groups).

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005

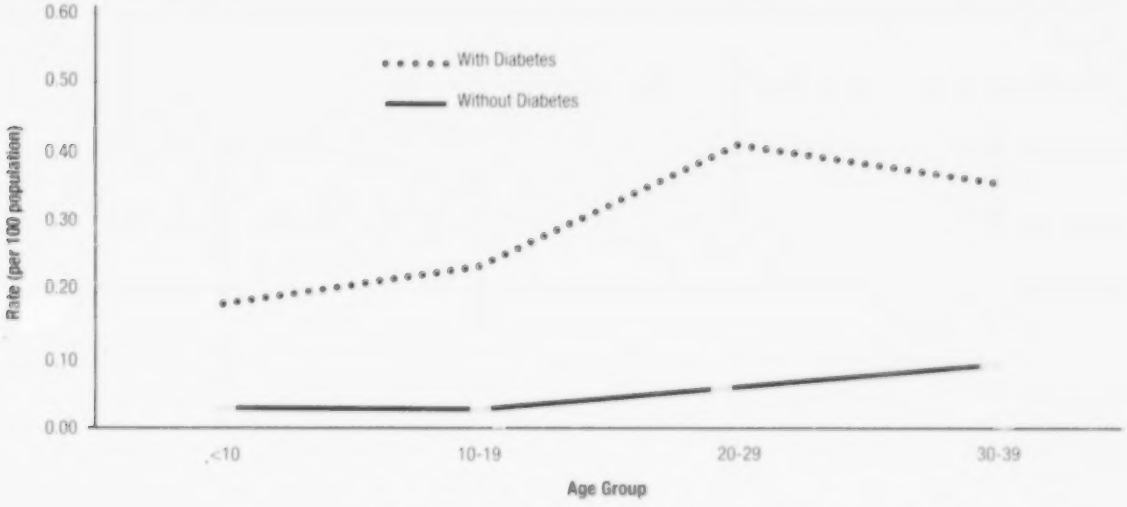
"Over 6,000 persons with previously diagnosed diabetes died in 2003/2004 – accounting for well over 20 per cent of all deaths in the province."

Persons with diabetes experience a greater risk of death due to direct complications of diabetes, other conditions associated with diabetes and its risk factors, and some causes not typically thought to be associated with diabetes. People with diabetes have a mortality rate that is about 2 times[4] (Rate Ratio = 2.1) higher than people without diabetes (Figure 2.8). The difference in rates is consistent for males and females. Over 6,000 persons with previously diagnosed diabetes died in 2003/2004 – accounting for well over 20 per cent of all deaths in the province.

[4] *The rate for diabetics (1.04) is divided by the rate for the non-diabetic comparison group (0.50), resulting in a rate ratio (RR) = 2.1.*

Figure 2.9a

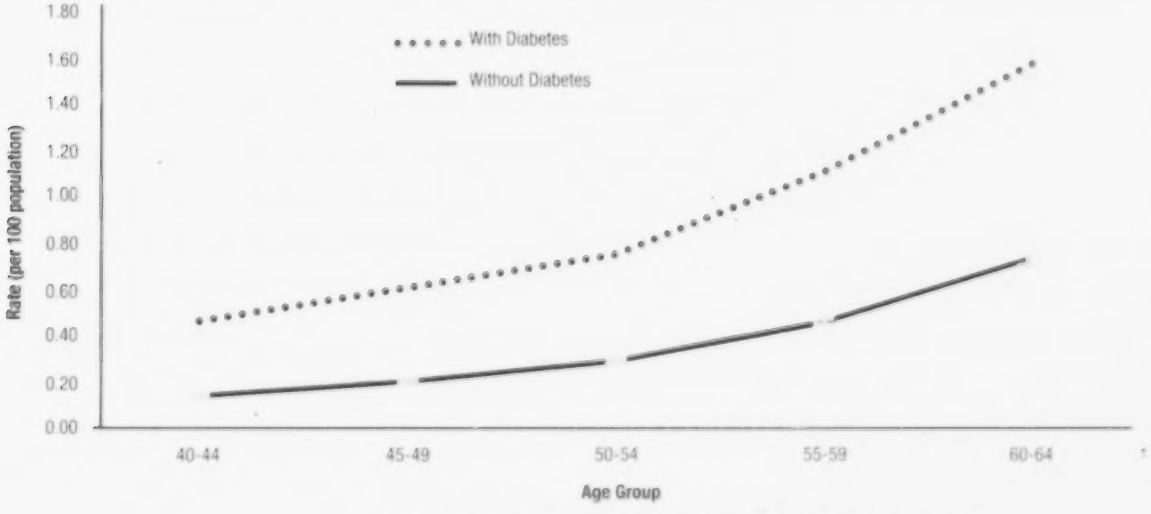
Age-Specific Mortality Rates, Ages < 10 to 39 years, Persons With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

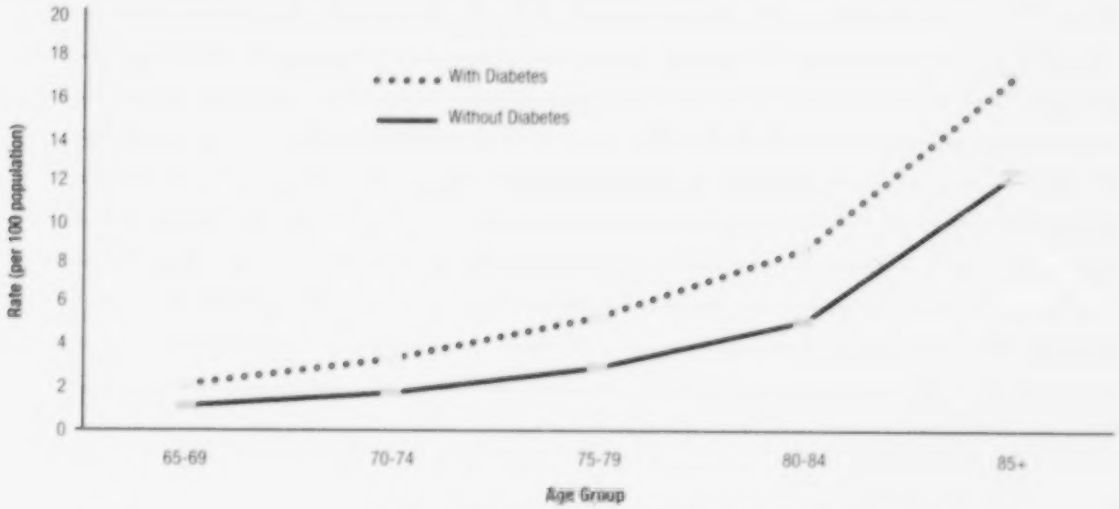
Figure 2.9b

Age-Specific Mortality Rates, Ages 40 to 64 years, Persons With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Figure 2.9c Age-Specific Mortality Rates, Ages 65 to 85+ years, Persons With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"Persons with diabetes have significantly higher mortality rates in all age groups."

As expected, the number of deaths of persons with diabetes increases with age. The age-specific mortality rates for the period 1998/1999-2002/2003 are presented in Figures 2.9a (age groups <10 to 39), 2.9b (age groups 40 to 64) and 2.9c (for age groups 65+). Persons with diabetes had significantly higher mortality rates across all age groups.

Table 2.3 Number of Deaths, Age-Specific Mortality Rates, and Rate Ratios for Persons With and Without Diabetes, by Age Group, BC, 1998/1999-2002/2003

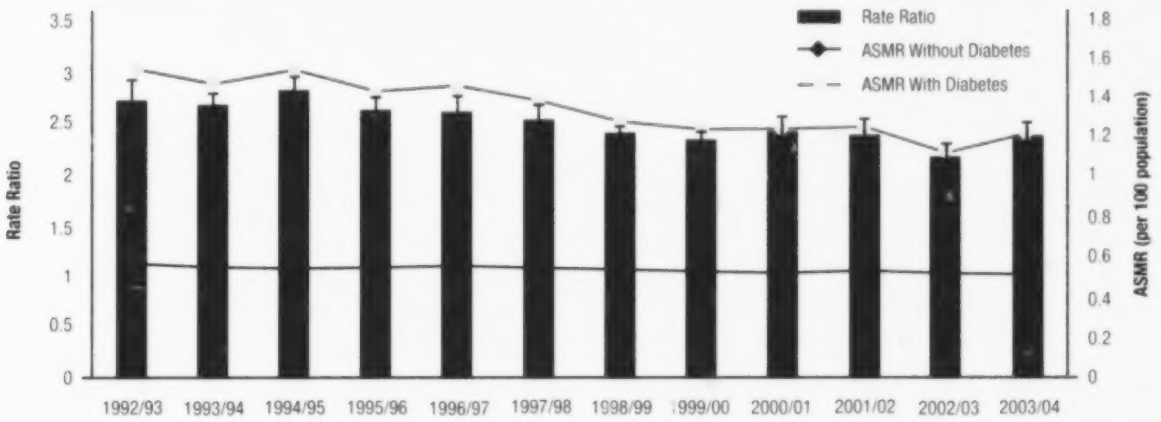
	With Diabetes		Without Diabetes		
Age	Deaths	Rate, per cent	Deaths	Rate, per cent	Rate Ratio
<1-9	5	0.18	528	0.02	7.2
10-19	21	0.24	738	0.03	8.3
20-29	61	0.41	1,536	0.06	6.3
30-39	147	0.36	2,705	0.09	3.9
40-44	185	0.47	2,307	0.14	3.4
45-49	360	0.62	3,059	0.20	3.1
50-54	622	0.76	3,870	0.30	2.6
55-59	1,032	1.12	4,520	0.46	2.4
60-69	1,565	1.58	5,454	0.73	2.2
65-69	2,578	2.34	7,489	1.17	2.0
70-74	3,982	3.63	10,795	1.91	1.9
75-79	5,251	5.69	15,014	3.19	1.8
80-84	5,393	9.12	17,487	5.42	1.7
85+	7,197	17.48	35,574	12.58	1.4
Total	28,399	3.34	111,076	0.60	2.1*

*The total Rate Ratio is based on age-standardized rates using the 1991 Canada population.

"From 1998/1999 to 2002/2003, there were over 28,000 deaths among people with diabetes."

Table 2.3 shows that the mortality rates for all age groups of persons with diabetes are elevated, as compared to persons without diabetes. The rate ratio shows the disparity between those with diabetes and those without diabetes. Ratios are many times higher in the younger age groups and remain substantially higher in the 85+ years age group (40 per cent higher). Over the 5-year period, there were over 28,000 deaths among people with diabetes. This represents about 20 per cent of all deaths in the province during that period.

Figure 2.10 Age-Standardized Mortality Rate (ASMR) and Rate Ratio for Persons With and Without Diabetes, BC, 1992/1993 to 2003/2004



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"In 2003/2004, the death rate among persons with diabetes was more than 2.5 times greater than for persons without diabetes."

It is important and encouraging to note that death rates for persons with and without diabetes have declined from 1992/1993 to 2003/2004 in British Columbia. The rate of decline is greater for persons with diabetes. The gap between persons with and without diabetes, while decreasing, remains substantial (Figure 2.10).

Detailed Cause of Death Comparison

Overall Mortality

In general, people with diabetes have higher mortality rates from all causes of death than those without the disease. Comparing specific causes of death over an expanded (1992/1993-2003/2004) time period shows that people with diabetes have an elevated risk (2.4 times) of dying from all causes of death (Figure 2.10) over the period 1992/1993 to 2003/2004.

Major Causes of Death

Table 2.4 shows age-standardized mortality rates with comparisons between persons with diabetes and persons without diabetes. Generally speaking, persons with diabetes experience increased risk of death in all categories. The majority of deaths of persons with diabetes are due to four broad causes: Diseases of the circulatory system (40 per cent), malignant neoplasms (cancer) (22 per cent), diabetes (13 per cent), and respiratory disease (9 per cent); they account for about 85 per cent of all deaths of persons with diabetes.

Within these broad categories, persons with diabetes account for a disproportionate number of deaths relative to their proportion of the population (5.2 per cent in 2003/2004). Persons with diabetes accounted for 21 per cent of all circulatory system deaths, 14 per cent of all malignant neoplasm deaths, 100 per cent of all deaths due to diabetes, and 15 per cent of respiratory system deaths. These high proportions are reflected in the differences in the age-standardized mortality rates for persons with diabetes and persons without diabetes. In all of these categories, the rate ratio (RR) for persons with diabetes is elevated: circulatory system (2.5 RR), malignant neoplasms (2.1 RR), and respiratory system (1.6 RR).

Cardiovascular Disease Mortality

More specific causes of death show even greater disparities between persons with and persons without diabetes. Acute myocardial infarction (heart attacks) and other ischaemic heart disease account for 23 per cent of all deaths for persons with diabetes. Death rates for these causes are 3 times higher among persons with diabetes (3.1 RR and 2.9 RR). The risk of death due to cerebrovascular diseases (stroke) is double for persons with diabetes (1.9 RR). Eight per cent of all deaths for persons with diabetes are due to stroke. Persons with diabetes also account for a disproportionate 18 per cent of all deaths due to stroke. The risk of death due to heart failure is double among persons with diabetes (who account for 20 per cent of all heart failure deaths). Similarly, other circulatory system causes show an increased risk and a disproportionate number of deaths for persons with diabetes.

Cancer Mortality

The malignant neoplasm (cancer) category accounts for a significant proportion of deaths and an elevated risk for persons with diabetes. People with diabetes have twice the risk of mortality for all types of cancers, specifically for cancers of trachea and lung (1.7 times), female breast (1.5 times), colon and rectum (1.8 times), cervix (2.4 times) and prostate (1.4 times). However, these comparisons were not adjusted for overweight and obesity, physical inactivity, or smoking, which are known risk factors for some cancers as well as for diabetes.

A major study (Jee et al, 2005) in Korea, a country with a low prevalence of obesity, found an association between Type 2 diabetes and the incidence and mortality due to all cancers, in particular certain digestive cancers, breast cancer, and cervical cancer. The authors found that this increased risk of mortality occurred at higher levels of fasting blood glucose, independently of Body Mass Index (BMI), which suggests that some of the cancer risk for people with diabetes is directly related to diabetes and not merely to obesity. An Ontario study (Lipscombe, Hux, & Booth, 2005) found that women with diabetes were significantly less likely than women without diabetes to have a mammogram, despite more health care visits, which raises issues around the provision of primary care for patients with chronic illness.

Respiratory Disease Mortality

In the respiratory system category, persons with diabetes experience higher risk of death for both pneumonia/influenza and chronic pulmonary disease (1.5 RR and 1.3 RR); persons with diabetes account for 16 per cent and 14 per cent of all deaths due to these causes respectively.

Mortality Due to Other Causes

Several other causes are notable for the increased risk of death experienced by persons with diabetes. Chronic renal disease carries over 4 times the risk of death for persons with diabetes (4.4 RR) and persons with diabetes account for 30 per cent of all deaths due to chronic renal disease. Chronic liver disease/cirrhosis has a similar risk (4.2 RR), and persons with diabetes account for 20 per cent of all deaths due to this cause. Possibly associated with this category is the three times greater risk (2.8 RR) for use of alcohol as a cause of death for persons with diabetes.

Finally, persons with diabetes account for a disproportionately high number of deaths—13 per cent—due to other causes not specifically listed in the table.

Table 2.4

Cause of Death Comparison for Persons With and Without Diabetes, by Diagnostic Chapter and Selected Causes, BC, 1992/1993-2003/2004

Cause of Death	Deaths With Diabetes	% Deaths With Diabetes	% of Cause Persons With Diabetes	Deaths Without Diabetes	% Deaths Without Diabetes	ASMR With Diabetes	ASMR Without Diabetes	Rate Ratio	Confidence Interval Rate Ratio	
									Lower	Upper
Certain infectious and parasitic diseases A00-B99	813	1.4	14.6	4,743	1.8	2.7	1.0	2.7	2.4	3.0
Malignant Neoplasms C00-D48	12,612	21.6	14.4	75,122	28.9	32.5	15.8	2.1	2.0	2.1
Malignant Neoplasms of trachea and lung C33-C34	2,931	5.0	12.7	20,111	7.7	7.1	4.2	1.7	1.6	1.8
Malignant Neoplasms of female breast C500-C509	755	1.3	10.9	6,140	2.4	2.0	1.3	1.5	1.4	1.7
Malignant Neoplasms of colon and rectum C18-C21	1,136	1.9	14.1	6,906	2.7	2.6	1.5	1.8	1.7	2.0
Cervical Cancer C53	63	0.1	11.3	494	0.2	0.2	0.1	2.4	1.7	3.3
Prostate Cancer C61	841	1.4	14.7	4,881	1.9	1.4	1.0	1.4	1.3	1.6
Other malignant neoplasms	6,886	11.8	15.8	36,590	14.1	N/A	N/A	N/A	—	—
Diabetes mellitus E10-E14	7,755	13.3	100.0	—	—	N/A	N/A	N/A	—	—
Mental and behavioural disorders F00-F99	787	1.3	11.2	6,210	2.4	1.7	1.3	1.3	1.2	1.5
Use of Alcohol F10	173	0.3	11.7	1,304	0.5	0.8	0.3	2.8	2.3	3.4
Other mental and behavioural disorders	614	1.0	11.1	4,906	1.9	N/A	N/A	N/A	—	—
Diseases of the nervous system G00-G99	1,108	1.9	10.2	9,802	3.8	2.5	2.1	1.2	1.0	1.5
Diseases of the circulatory system I00-I99	23,628	40.4	20.5	91,572	35.2	47.1	19.1	2.5	2.4	2.5
Acute Myocardial Infarction I21-I22	7,058	12.1	23.2	23,418	9.0	15.2	4.9	3.1	3.0	3.2
Other Ischemic heart diseases I20, I23-I25	6,264	10.7	22.9	21,121	8.1	12.6	4.4	2.9	2.8	3.0
Cerebrovascular diseases I60-I69	4,775	8.2	18.3	21,265	8.2	8.3	4.4	1.9	1.8	2.0
Hypertensive Disease I10-I13, I15	450	0.8	19.6	1,842	0.7	0.9	0.4	2.4	2.1	2.7
Heart Failure I50	1,655	2.8	20.1	6,566	2.5	2.6	1.4	1.9	1.8	2.0
Diseases of Arteries I70-I78	963	1.6	14.3	5,775	2.2	1.8	1.2	1.5	1.4	1.6
Other diseases of the circulatory system	2,463	4.2	17.5	11,585	4.4	N/A	N/A	N/A	—	—

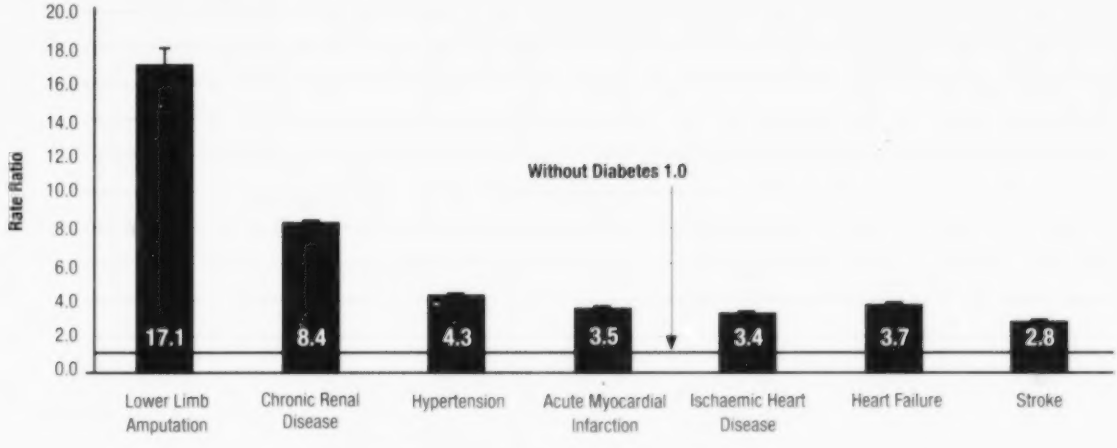
Table 2.4
(continued)

Cause of Death	Deaths With Diabetes	% Deaths With Diabetes	% of Cause Persons With Diabetes	Deaths Without Diabetes	% Deaths Without Diabetes	ASMR With Diabetes	ASMR Without Diabetes	Rate Ratio	Confidence Interval Rate Ratio	
									Lower	Upper
Diseases of the respiratory system J00-J99	5,096	8.7	15.3	28,294	10.9	9.2	5.9	1.6	1.5	1.6
Pneumonia/Influenza J10-J181,J188,J189	2,297	3.9	15.6	12,381	4.8	3.9	2.6	1.5	1.4	1.6
Chronic Pulmonary Disease J40-J44	1,902	3.3	14.2	11,492	4.4	3.2	2.4	1.3	1.3	1.4
Other diseases of the respiratory system	897	1.5	16.9	4,421	1.7	N/A	N/A	N/A	—	—
Diseases of the digestive system K00-K93	2,205	3.8	18.1	9,966	3.8	5.8	2.1	2.8	2.6	2.9
Chronic liver disease/cirrhosis K70,K73-K74, K	652	1.1	19.9	2,630	1.0	2.3	0.6	4.2	3.8	4.7
Other diseases of the digestive system	1,553	2.7	17.5	7,336	2.8	N/A	N/A	N/A	—	—
Diseases of the genitourinary system N00-N99	1,446	2.5	27.4	3,835	1.5	2.9	0.8	3.6	3.4	3.9
Renal Disease N18-N19	949	1.6	30.4	2,177	0.8	2.0	0.5	4.4	4.0	4.8
Other diseases of the genitourinary system	497	0.8	23.1	1,658	0.6	N/A	N/A	N/A	—	—
External causes of morbidity and mortality V01-Y89	1,489	2.5	6.7	20,776	8.0	5.5	4.5	1.2	1.1	1.4
Accidental Poisoning X40-X49	138	0.2	3.7	3,591	1.4	0.9	0.8	1.2	1.0	1.4
Suicide X60-X84, Y870	278	0.5	5.3	4,962	1.9	1.4	1.1	1.3	1.1	1.5
Adverse Affects of Drugs Y40-Y59	26	0.0	16.7	130	0.0	0.1	0.0	2.8	1.6	4.8
Med/Surg misadventure, etc. Y60-Y84	62	0.1	21.8	222	0.1	0.1	0.0	3.2	2.2	4.6
Falls W00-W19	548	0.9	13.8	3,424	1.3	1.0	0.7	1.3	1.2	1.5
Other external causes of morbidity and mortality	437	0.7	4.9	8,447	3.2	N/A	N/A	N/A	—	—
Other Causes	1,540	2.6	13.3	10,031	3.9	N/A	N/A	N/A	—	—
All Causes	58,479	100.0	18.3	260,351	100.0	133.3	54.8	2.4	2.4	2.5

*Note: Figure 2.8 and Table 2.4 present rate ratios based on different data over different time periods and using different age groupings for the underlying age-standardized mortality rates. As such, the rate ratios may not be directly comparable. Figure 2.8 is using probabilistic linkage to overall death counts, age-standardized mortality rates and rate ratios over a 5-year period (age-standardized using 14 age groups). Table 2.4 is using deterministic linkage to cause of death counts, age-standardized mortality rates, and rate ratios over a 12-year period (age-standardized using three age groups). Age-standardized mortality rate (ASMR) per 10,000 and rate ratio with 95 per cent confidence interval (CI).

Conditions Associated With Diabetes

Figure 2.11 Age-Standardized Hospitalization Rate Ratios for Selected Associated Conditions, Persons With and Without Diabetes, BC, 1992/1993-2003/2004



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"Over the time period 1992/1993 to 2003/2004, persons with diabetes experienced more than 17 times the yearly rate of hospitalization for amputations, 8 times for chronic renal disease, and 3 to 4 times for cardiovascular disease compared to those without diabetes."

People with diabetes experience much higher rates of hospitalization for other conditions often associated with diabetes (Figure 2.11). These conditions are sometimes direct complications of diabetes (such as chronic renal disease, lower limb amputations, etc.) but are often co-morbid conditions (co-existing medical conditions) related to many of the lifestyle-influenced risk factors that lead to the development of Type 2 diabetes (e.g., high blood pressure, heart disease, heart attacks, heart failure, etc.). Over the time period 1992/1993 to 2003/2004, age-standardized rates show that persons with diabetes experienced more than 17 times the yearly rate of hospitalization for amputations, 8 times the yearly rate of hospitalization for chronic renal disease, and 3-4 times the yearly rate of hospitalization for cardiovascular-related conditions compared to those without diabetes (International Classification of Diseases (ICD) codes for Figure 2.11 are provided in Appendix D).

Tables 2.5 through 2.7 show the relative proportions and costs of these various conditions between persons with and without diabetes. Nearly one-third of persons with diabetes in 2003/2004 had one or more of these conditions as compared to only 5 per cent of people without diabetes.[5] Adjusting for the older age structure of the diabetes population still results in a rate ratio that is 2 to 4 times higher for cardiovascular-related conditions, 6 times higher for chronic renal disease, and 12.5 times higher for amputations (Table 2.5). In addition, persons with diabetes account for a very high proportion of all persons who experience these conditions.

As seen in Table 2.6, overall, adjusted costs per person are about 3 times higher for persons with diabetes. For persons with diabetes who also have any of the selected conditions, costs are about 50 per cent higher. Persons with diabetes account for a very high proportion of costs associated with these selected conditions.[6]

Of course, since many persons with diabetes experience more of the associated conditions than those who do not have diabetes, the burden of illness and the associated costs are much higher (see Tables 2.6 and 2.7).

Table 2.5

Prevalence of Selected Co-morbid Hospitalized Conditions Associated with Diabetes, BC, 2003/2004*

Selected Hospitalized Conditions	Persons with Diabetes: Persons with Conditions	Persons with Diabetes: Per cent of Diabetics with Condition	Persons with Diabetes: Per cent of those with Condition who have Diabetes	Persons with vs Persons without Diabetes Rate Ratio: Age-Standardized Rate Ratio	Persons without Diabetes: Number with Condition	Persons without Diabetes: Per cent of Non-Diabetics with Condition
No co-morbid condition	150,472	69.5	3.8	—	3,823,626	94.9
Cardiovascular Diseases (CVD)	65,434	30.2	24.5	2.5	201,702	5.0
Ischaemic Heart Diseases (IHD)	32,369	15.0	29.0	3.6	79,187	2.0
Acute Myocardial Infarction	13,281	6.1	29.4	2.8	31,833	0.8
Other IHD	19,088	8.8	28.7	N/A	47,354	1.2
Hypertension	40,564	18.7	31.2	3.4	89,447	2.2
Heart Failure	14,184	6.6	33.9	3.3	27,702	0.7
Stroke	12,496	5.8	26.9	2.3	34,017	0.8
Other CVD	5,866	2.7	12.3	N/A	41,734	1.0
Chronic Renal Disease	5,650	2.6	41.1	6.7	8,086	0.2
Lower Limb Amputation	1,289	0.6	59.5	12.5	877	0.1
Any co-morbid condition	66,016	30.5	24.5	N/A	203,561	5.1
All persons	216,488	—	5.1	—	4,027,187	—

*Persons living in 2003/2004 who have been hospitalized at any time during the period 1992/1993 – 2003/2004 for the listed conditions. Persons may be counted in more than one category since they may have more than one condition (15 per cent of persons with diabetes have more than one condition).

[5] *Count is not adjusted for under count due to case definition.*

[6] *For Table 2.6, comparisons of costs can be made for persons with and without diabetes for each of the hospitalized condition categories.*

Table 2.6

Cost of Various Conditions Associated with Diabetes, BC, 2003/2004*

Selected Hospitalized Conditions	Persons with diabetes			Persons without diabetes			Age-Standardized Cost Rate Ratio (per person)
	Cost	Per cent of Costs for those with Diabetes	Cost per person**	Cost	Per cent of costs for those without Diabetes	Cost per person**	
No co-morbid condition	$364,406,000	10.0	$2,413	$3,279,682,000	90.0	$858	2.81
Cardiovascular Diseases (CVD)	$666,728,000	32.4	$10,456	$1,392,825,000	67.6	$6,905	1.51
Ischaemic Heart Diseases (IHD)	$366,232,000	37.9	$11,282	$600,391,000	62.1	$7,582	1.49
Acute Myocardial Infarction	$172,657,000	39.3	$12,823	$267,014,000	60.7	$8,388	1.53
Other IHD	$193,575,000	36.7	$10,141	$333,376,000	63.3	$7,040	1.44
Hypertension	$435,941,000	39.5	$10,879	$668,306,000	60.5	$7,472	1.46
Heart Failure	$246,251,000	42.2	$18,014	$337,921,000	57.8	$12,198	1.48
Stroke	$157,610,000	34.3	$12,757	$301,297,000	65.7	$8,857	1.44
Other CVD	$46,048,000	17.3	$7,578	$219,365,000	82.7	$5,256	1.44
Chronic Renal Disease	$144,621,000	52.0	$24,748	$133,638,000	48.0	$16,527	1.50
Lower Limb Amputation	$33,497,000	73.2	$23,896	$12,248,000	26.8	$13,966	1.71
Any co-morbid condition	$676,559,000	32.4	$10,510	$1,413,011,000	67.6	$6,941	1.51
All persons	$1,040,965,000	18.1	$3,462	$4,692,694,000	81.8	$1,165	2.97

*Cost estimates are derived by attributing all costs (Hospital, Medical Services Plan, PharmaCare) in a given year to two groups—either persons with diabetes or persons without diabetes.

**Costs for persons with diabetes are adjusted to reflect the age structure of the population without diabetes.

Table 2.7

Percentage of Persons With and Without Diabetes, by Number of Diabetes-Associated Conditions, BC, 2003/2004

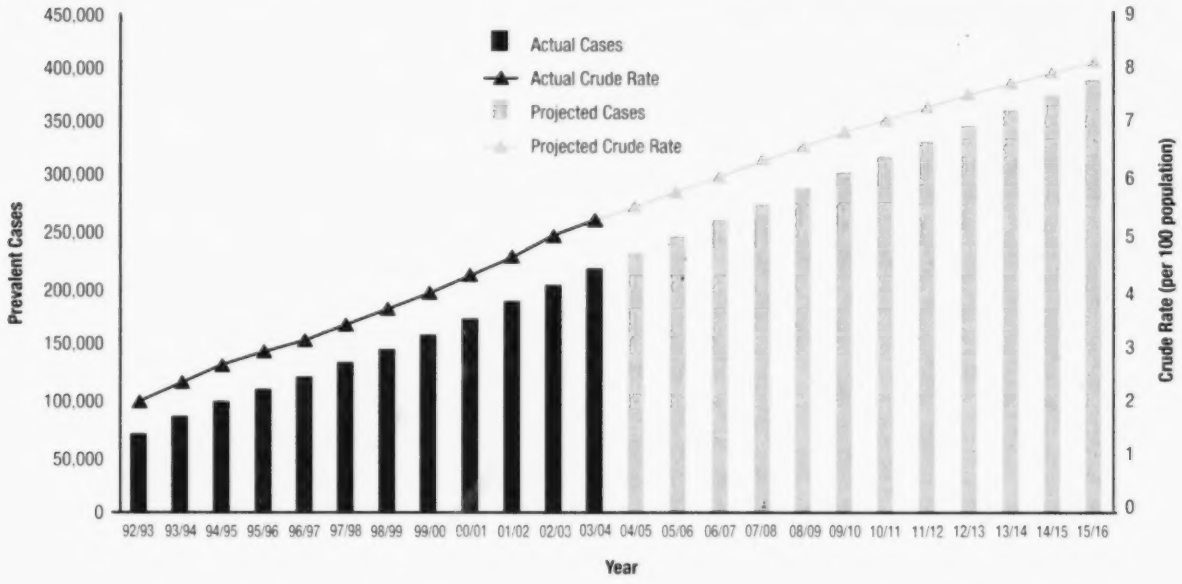
Number of Diabetes Associated Conditions	Per Cent of Persons with Diabetes	Per Cent of Persons without Diabetes	Age-Standardized Rate Ratio
0	69.51	94.95	—
1	16.23	3.60	2.1
2	9.00	1.07	3.0
3	3.68	0.31	3.9
4	1.29	0.07	5.7
5	0.27	0.01	9.9
6	0.02	<0.001	30.4
Total	100.0	100.0	

Table 2.7 shows that persons with diabetes are burdened with a greater number of conditions often associated with diabetes. After adjusting for differences in age, persons with diabetes are 2 times as likely to have one of the associated conditions, 3 times as likely to have 2 conditions, 4 times as likely to have 3 conditions, 6 times as likely to have 4 conditions, 10 times as likely to have 5 conditions, and 30 times as likely to have all 6 of the selected conditions.

Prevalence Projections

The prevalence of diabetes is increasing over time. This trend is consistent across age groups. This is due to a relatively steady incidence that is greater than the loss of cases due to death or migration, with the exception of the 80–84 and 85+ age categories. Even though deaths exceed newly diagnosed cases in these older age categories, the overall prevalence continues to go up as existing prevalent cases age and enter the next age group. This more than offsets the loss of cases due to death or migration.

Figure 2.12a Diabetes Prevalence Projections, BC, Cases and Crude Rates, 1992/1993 to 2015/2016

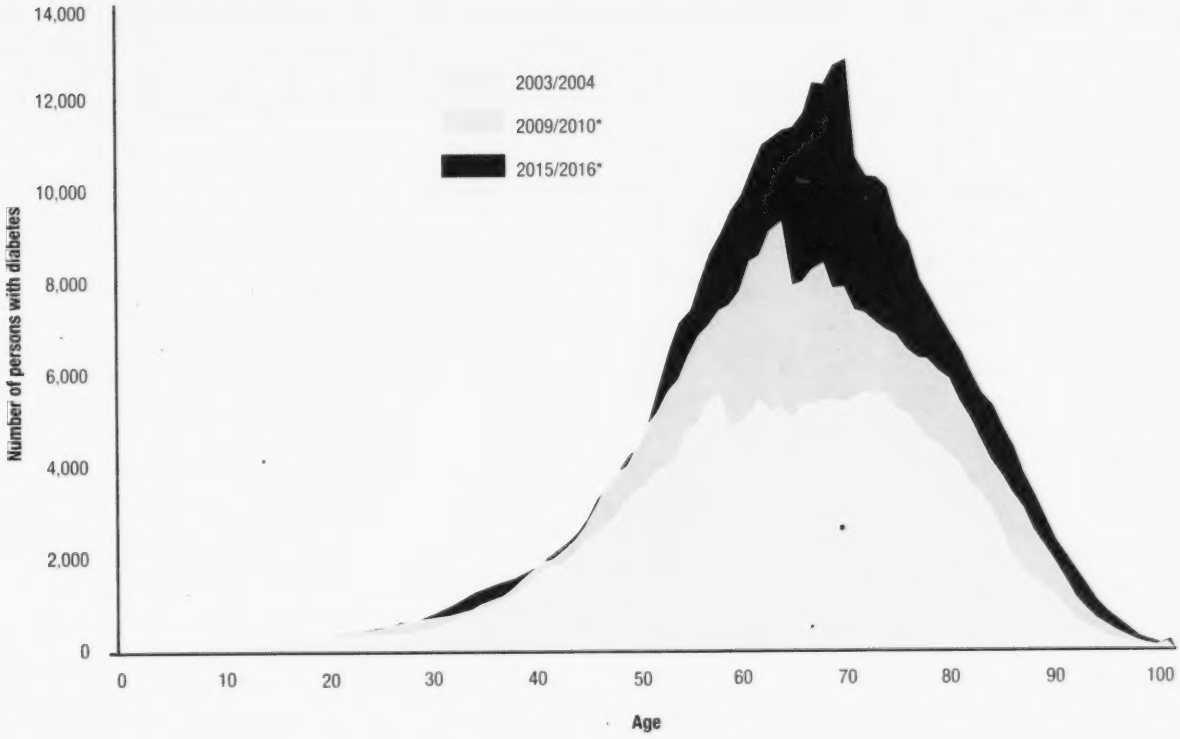


Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"With no reduction in the rate of incidence and the decline in mortality, it is estimated that from 2003/2004 to 2015/2016, the number of persons with diabetes will increase to just over 390,000 – an increase of 77 per cent."

With no reduction in the rate of incidence and with the decline in mortality, the overall prevalence will continue to increase. Assuming that current trends will continue, the crude prevalence rate will rise from 5.2 per cent in 2003/2004 to 8.1 per cent in 2015/2016—an increase of 55 per cent. As shown in Figure 2.12a, the number of persons with diabetes will increase from 220,000 to just over 390,000—an increase of 77 per cent (see Appendix F for the projection formulas and Appendix C for the projection methodology).

Figure 2.12b Diabetes Prevalence Projections, Age-Specific Distribution of Cases, BC, 2003/2004 to 2015/2016



*Projected cases

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"The older age groups (those 40 years of age and older) will experience a 30 to 40 per cent increase in the prevalence rate of diabetes by the year 2015/2016."

The numbers of persons with diabetes in some age groups are expected to double over the next 10 to 15 years with a corresponding increase in the age-specific rates (Figure 2.12b and Table 2.8). The older age groups (40 years and older) will experience a 30 to 40 per cent increase in the prevalence rate of diabetes. The increase in diabetes in older age groups is expected to bring with it a comparable increase in the associated conditions such as heart disease and chronic renal disease. Accordingly, these age groups will use health care resources at a much higher rate than other age groups in the population.

Table 2.8

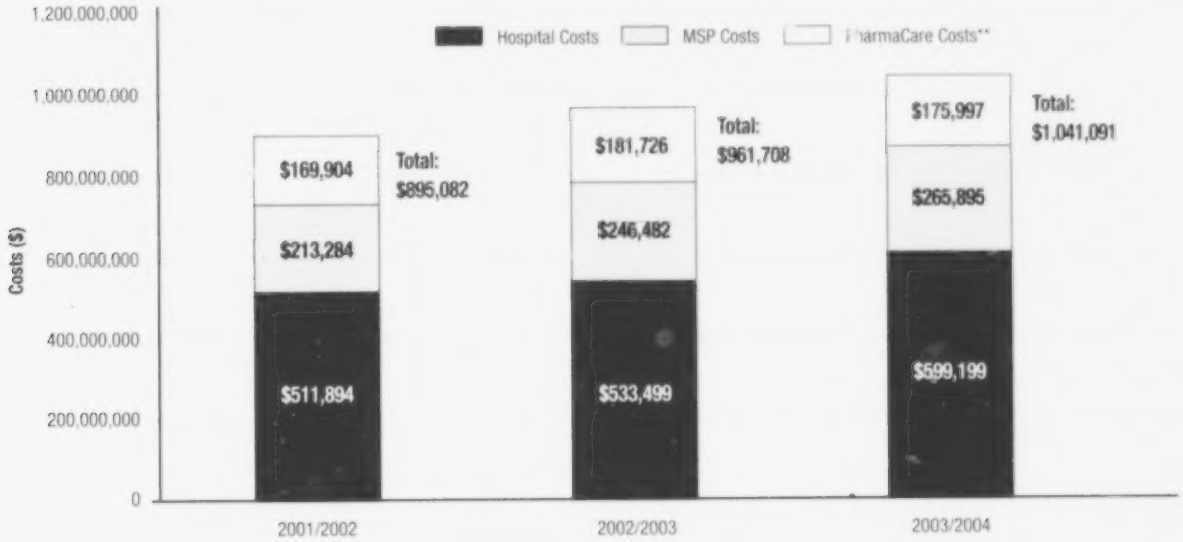
Projection of Crude Prevalence and Age-Specific Rates of Diabetes for 2003/2004, 2009/2010, and 2015/2016

	2003/2004			2009/2010*			2015/2016*			2003/2004 to 2015/2016	2003/2004 to 2015/2016
	Cases	Population	Rate, Per cent	Cases	Population	Rate, Per cent	Cases	Population	Rate, Per cent	Rate Per cent Change	Cases Per cent Change
<1-9	676	445,088	0.2	638	435,008	0.1	665	466,149	0.1	-6.1	-1.6
10-19	2,143	552,863	0.4	2,438	527,766	0.5	2,396	499,917	0.5	23.6	11.8
20-29	3,792	560,311	0.7	5,146	625,686	0.8	5,622	634,138	0.9	31.0	48.3
30-39	9,902	610,589	1.6	11,298	613,669	1.8	13,701	706,234	1.9	19.6	38.4
40-49	24,746	713,286	3.5	30,317	702,588	4.3	31,367	677,240	4.6	33.5	26.8
50-59	46,364	573,280	8.1	64,658	667,326	9.7	77,167	721,288	10.7	32.3	66.4
60-69	53,101	357,873	14.8	83,872	473,291	17.7	117,153	596,451	19.6	32.4	120.6
70-79	50,867	260,892	19.5	66,911	276,152	24.2	89,445	331,925	26.9	38.2	75.8
80+	28,589	169,493	16.9	42,568	204,904	20.8	54,353	226,784	24.0	42.1	90.1
All ages	220,180	4,243,675	5.2	307,846	4,961,398	6.2	391,869	4,860,126	8.1	55.4	78.6

*Projected cases.

Cost of Diabetes in British Columbia

Figure 2.13 Total Estimated Health Services Costs for Persons With Diabetes, BC, 2001/2002 to 2003/2004*



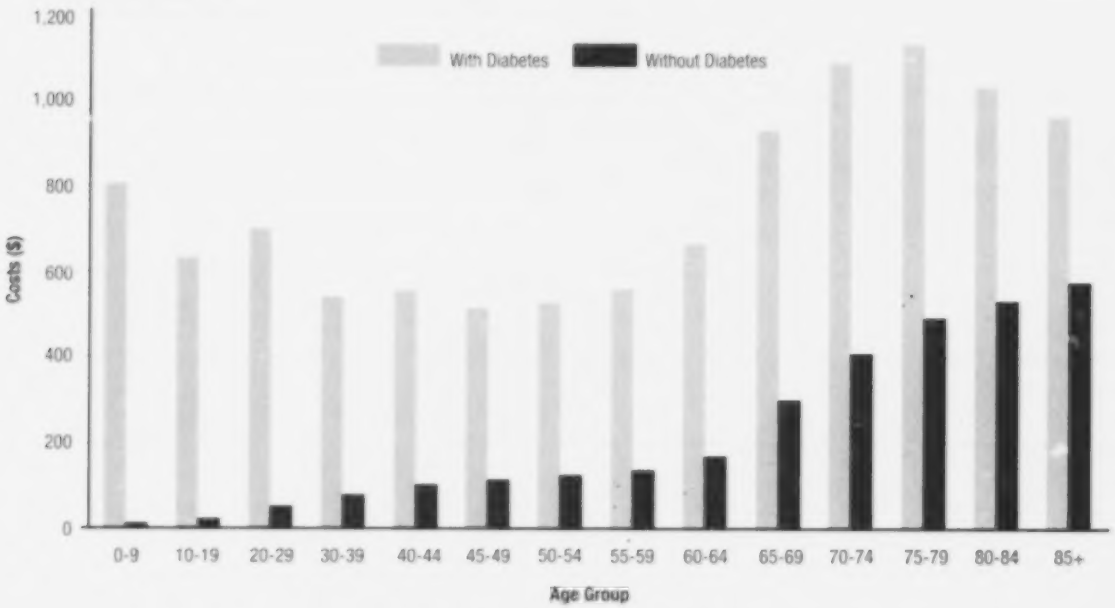
* Cost estimates are derived by attributing all costs (Hospital, Medical Services Plan, PharmaCare) in a given year to two groups—either persons with diabetes or persons without diabetes. Costs are constant 2003/2004 dollars. These estimates exclude both health-related costs for which the responsibility for payment falls on the individual person with diabetes, and other government-funded health care expenses (e.g., costs for long-term care).

** PharmaCare implemented significant changes to its deductible structure on January 01, 2002 and on May 01, 2003.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005

By using surveillance data, it is possible to aggregate costs from three sources of administrative data—hospitals, Medical Services Plan, and PharmaCare for persons living with diabetes (216,000 persons in 2003/2004 – not adjusted for under count due to case definition). Figure 2.13 demonstrates how these three sources contribute to the total costs to the health system for persons with diabetes. These costs include not only costs due to diabetes and diabetes-associated conditions, but costs that persons with diabetes might incur if they did not have diabetes. It is also important to note the general increase in most of these different costs over time.

Figure 2.14 Average PharmaCare Costs, Persons With and Without Diabetes, by Age Group, 2003/2004*



* Cost estimates are derived by attributing all PharmaCare costs in a given year to two groups—either persons with diabetes or persons without diabetes. Costs are constant 2003/2004 dollars. These estimates exclude costs for which the responsibility for payment falls on the individual person with diabetes. PharmaCare implemented significant changes to its deductible structure on January 01, 2002 and on May 01, 2003.

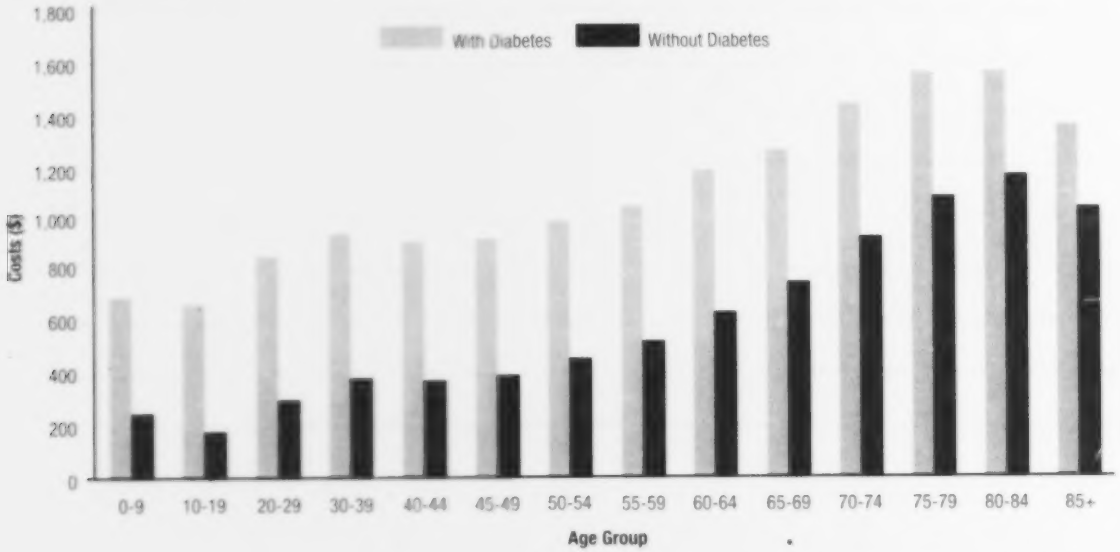
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"In 2003/2004, persons with diabetes accounted for 19 per cent of hospital costs, 14 per cent of Medical Services Plan costs, and 27 per cent of PharmaCare costs."

These costs and services comprise all hospital, Medical Service Plan, and PharmaCare services provided to persons with diabetes and include services for conditions other than diabetes. The services due to other conditions are largely those required to treat and manage conditions such as cardiovascular disease, renal disease, and other conditions that are either direct complications of diabetes, or are strongly associated with diabetes and its risk factors. While the prevalence of diabetes is 5.2 per cent, the diabetic cohort accounts for 18 per cent of the total expenditures for hospital, Medical Services Plan, and PharmaCare services in 2003/2004. Within each program, persons with diabetes account for 19 per cent of hospital costs, 14 per cent of Medical Services Plan costs, and 27 per cent of PharmaCare costs.

While the differences between persons with and without diabetes are substantial, this is due in part to the differing age structure of the populations. Because persons with diabetes are older, their costs are higher in part due to increased morbidity and health service utilization of older persons in general. However, most of the increased cost for persons with diabetes is due to the extra burden of disease that these persons bear because of diabetes and its direct complications and associated co-morbid conditions.

Figure 2.15a Average Medical Services Plan Costs, Persons With and Without Diabetes, by Age Group, 2003/2004*



* Cost estimates are derived by attributing all Medical Services Plan costs in a given year to two groups —either persons with diabetes or persons without diabetes. Costs are constant 2003/2004 dollars.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"In 2015/2016, the proportion of the total expenditures for hospital, Medical Services Plan, and PharmaCare services for persons with diabetes is projected to be 34 per cent, almost double the figure in 2003/2004."

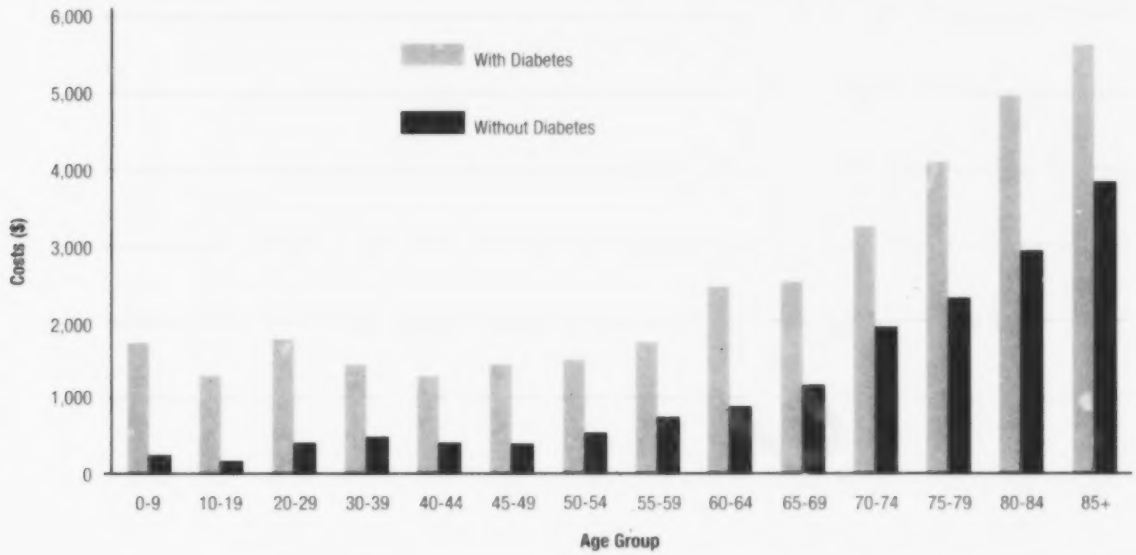
Figures 2.14 to 2.16 show the differences in costs on an age-specific basis for the year 2003/2004, by program. Increased costs are consistent across all age groups, and even in the oldest age groups, the gap between persons with diabetes and persons without diabetes remains substantial. In 2003/2004, if the diabetic cohort had the same age-specific costs as the non-diabetic cohort, the estimated total health savings in 2003/2004 would be $531,000,000.

As the diabetic cohort continues to age and increase in number, the health services costs incurred by persons with diabetes will continue to grow disproportionately. As a result, both absolute and proportionate costs will continue to increase.

As the prevalence rate increases over time (approximately 0.3 per cent per year), the proportion of expenditures incurred by persons with diabetes will increase as well, but at a greater rate (approximately 1.3 per cent per year). Thus in 2015/2016, the crude prevalence of diabetes is projected to be 8.1 per cent, and the proportion of total expenditures for hospital, Medical Services Plan, and PharmaCare services for persons with diabetes is projected to be 34 per cent, almost double the figure in 2003/2004.

Note that these estimates exclude both health-related costs for which the responsibility for payment falls on the individual person with diabetes, and other government-funded health care expenses (e.g., costs for long-term care).

Figure 2.15b Average Hospital Costs, Persons With and Without Diabetes, by Age Group, 2003/2004*

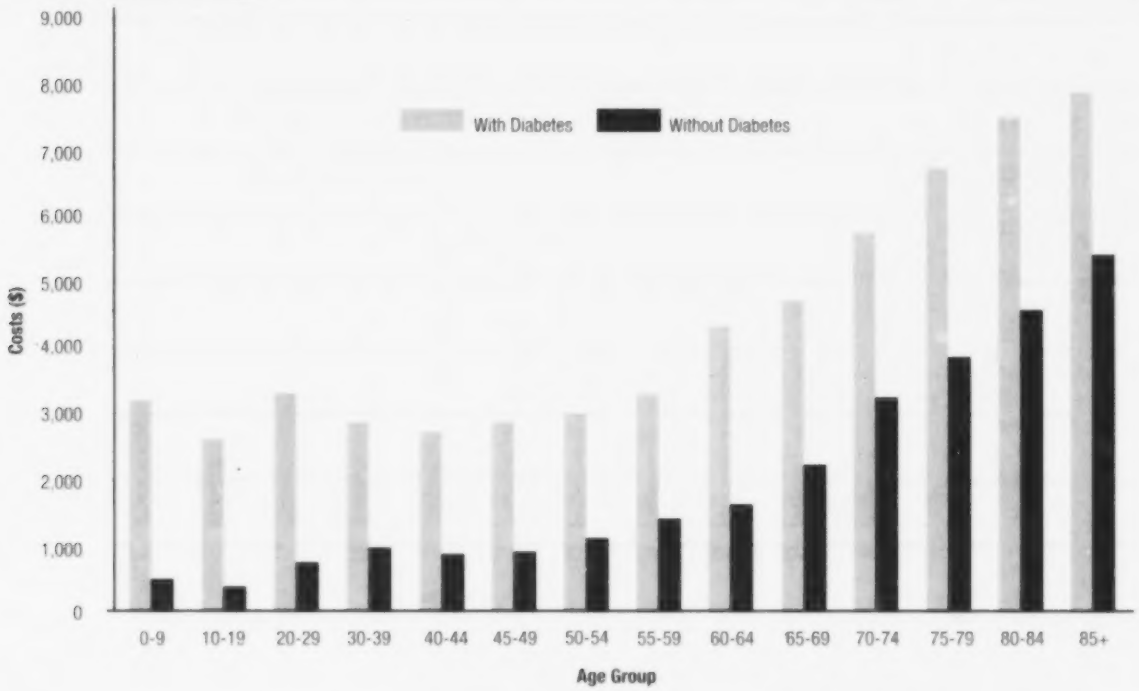


* Cost estimates are derived by attributing all hospital costs in a given year to two groups—either persons with diabetes or persons without diabetes. Costs are constant 2003/2004 dollars. These estimates exclude both health-related costs for which the responsibility for payment falls on the individual person with diabetes, and other government-funded health care expenses (e.g. costs for long-term care).

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Based on the projection methods employed earlier for diabetes prevalence, current government funded costs of approximately $1.04 billion for hospital, Medical Services Plan, and PharmaCare services for people with diabetes will rise to approximately $1.90 billion by 2015/2016, if current trends continue—an increase of $900,000,000, or just over 80 per cent. However, these estimates inflate the cost of diabetes because they do not exclude the average cost attributable to an equal number of similarly aged persons without diabetes.

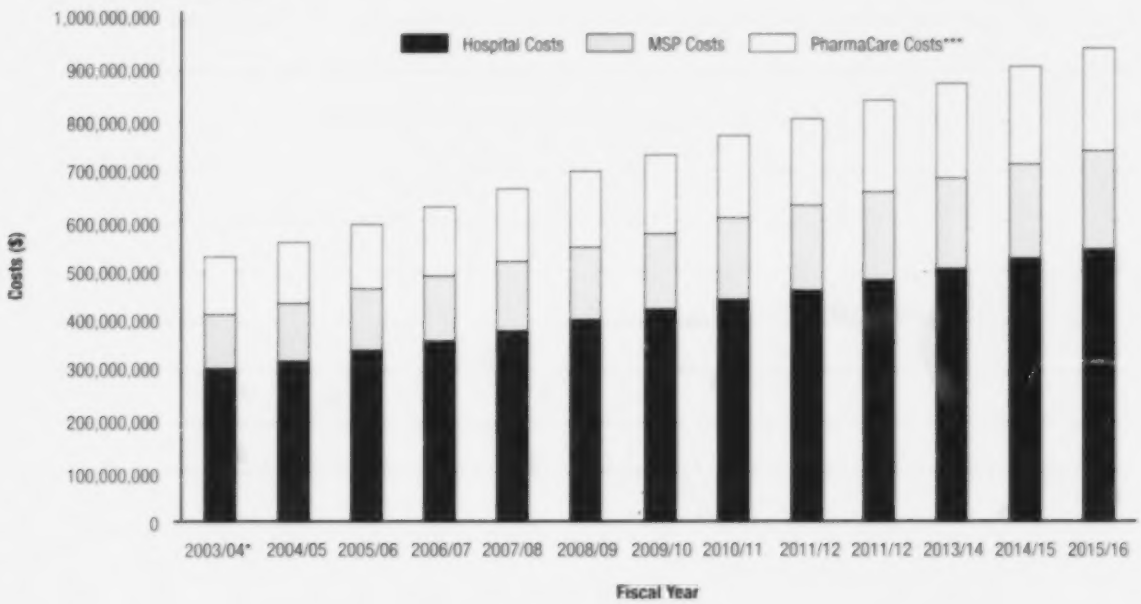
Figure 2.16 Average Combined PharmaCare, Medical Services Plan, and Hospital Costs, Persons With and Without Diabetes, by Age Group, 2003/2004*



* Cost estimates are derived by attributing all costs (Hospital, Medical Services Plan, PharmaCare) in a given year to two groups—either persons with diabetes or persons without diabetes. Costs are constant 2003/2004 dollars. These estimates exclude both health-related costs for which the responsibility for payment falls on the individual person with diabetes, and other government-funded health care expenses (e.g., costs for long-term care). PharmaCare implemented significant changes to its deductible structure on January 01, 2002 and on May 01, 2003.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Figure 2.17 Projected Additional Health Services Costs for Persons With Diabetes, BC, 2003/2004 to 2015/2016**



* Actual costs.

** Cost estimates are derived by attributing all costs (Hospital, Medical Services Plan, Pharmacare) in a given year to two groups—either persons with diabetes or persons without diabetes. Costs are constant 2003/2004 dollars. These estimates exclude both health-related costs for which the responsibility for payment falls on the individual person with diabetes, and other government-funded health care expenses (e.g., costs for long-term care).

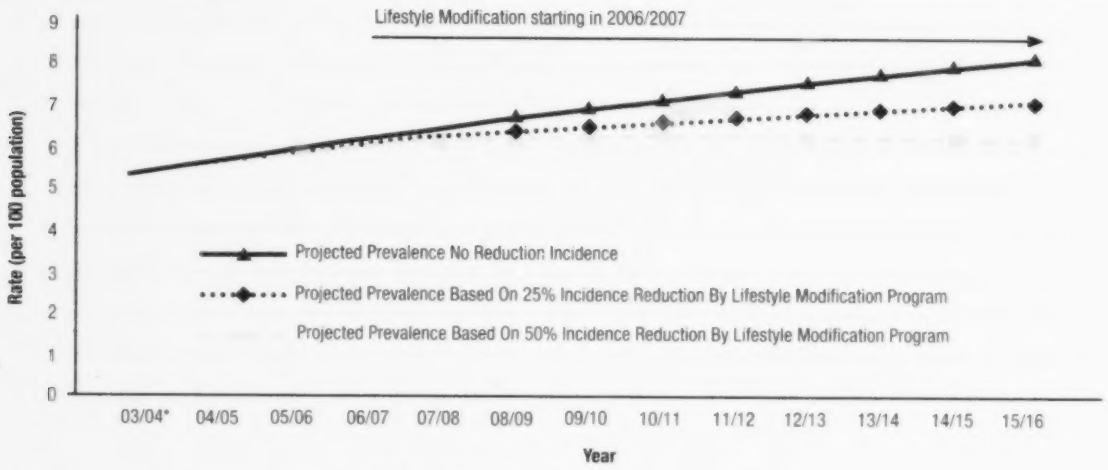
*** PharmaCare implemented significant changes to its deductible structure on January 01, 2002 and on May 01, 2003.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Of the $1.04 billion in costs incurred by persons with diabetes in 2003/2004, $531,000,000 are over and above costs for the same number of persons without diabetes but with the same age distribution.[8] By 2015/2016, this amount is projected to increase to nearly $938,000,000. These are additional costs for providing government-funded PharmaCare, Medical Services Plan, and hospital services to persons with diabetes over and above those that would be provided to the same group of persons without diabetes. (Figure 2.17) Cumulatively, over the 12-year period from 2004/2005 to 2015/2016, the "extra" costs for persons with diabetes will total approximately $9 billion.

[8] *In order to estimate the additional costs of diabetes to the health care system, the diabetes costing method involved an age adjusted comparison of hospital, Medical Services Plan, and PharmaCare costs for people with diabetes, minus the same program costs for people without diabetes. This method allows for all costs experienced by diabetics to be counted, while subtracting those average population costs which are incurred by a similarly aged cohort of non-diabetics.*

Figure 2.18 Diabetes Prevalence Projections, Crude Rates, BC, 2003/2004 to 2015/2016



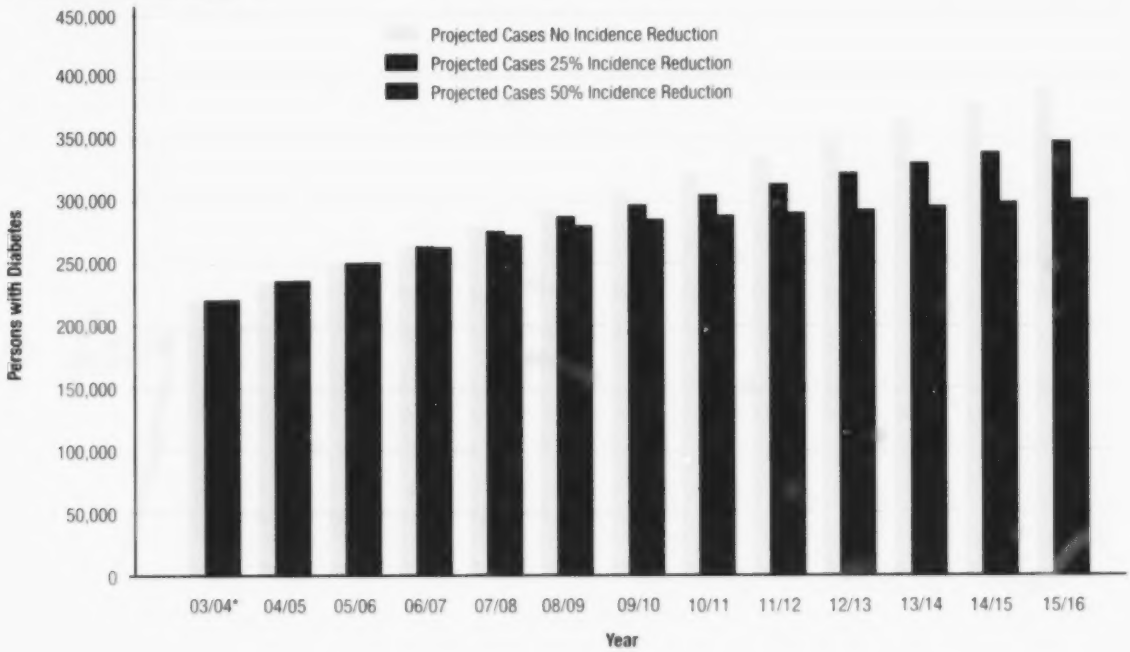
*Actual prevalence.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

However, it may be possible to slow the rate of increase in the incidence of diabetes and thereby reduce the rate of increase in prevalence, through the implementation of lifestyle modification programs. This could have the effect of reducing costs as well. Figures 2.18 and 2.19 show the effect that a lifestyle modification program could have on the trend in increasing prevalence.[9] For example, if such a program was implemented in 2006/2007 and a 50 per cent reduction in the incidence of diabetes was achieved within 5 years, the prevalence rate of diabetes would stabilize and begin a very slight decline beginning in 2010/2011.

[9] *For the purpose of this analysis, the resulting estimates were modelled from a widely reported study involving a nutritional and physical activity intervention for non-diabetics at risk of developing diabetes (Diabetes Prevention Program Research Group, 2002) It must be acknowledged that the results of a specific clinical trial are not necessarily attainable at the population level, but can assist in the development of goals for a population prevention strategy.*

Figure 2.19 Diabetes Prevalence Projections, BC Cases, 2003/2004 to 2015/2016

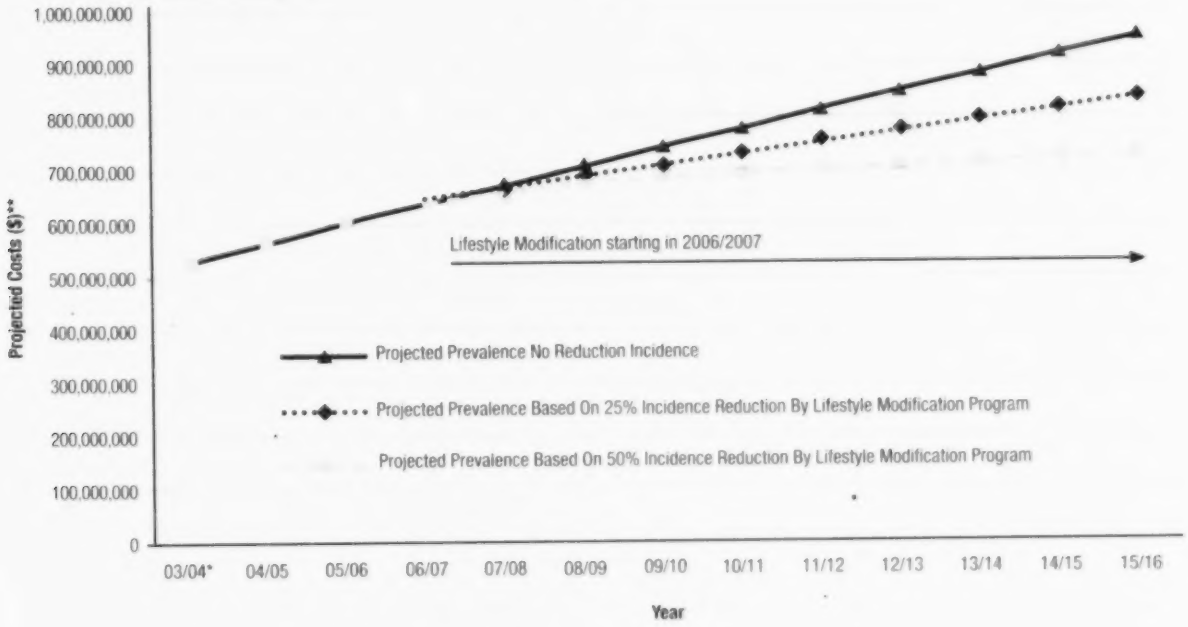


*Actual cases.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Despite the decline in the prevalence rate, the number of persons would continue to rise as the population of BC continues to grow. Alternatively, a 25 per cent reduction would result in prevalence (both rates and numbers of prevalent cases) continuing to rise well past the end of the projection period, although to a lesser degree. In reality, it will be a challenge to achieve such large reductions in the rate of incidence in the population as a whole, and the increase in prevalence of diabetes may continue beyond 2015/2016, while prevention strategies are developed and implemented.

Figure 2.20 Projected Additional Health Services Costs for Persons With Diabetes With Implementation of Lifestyle Modification Program, BC, 2003/2004 to 2015/2016



* Actual costs.

** Cost estimates are derived by attributing all costs (Hospital, Medical Services Plan, PharmaCare) in a given year to two groups—either persons with diabetes or persons without diabetes. Costs are constant 2003/04 dollars. These estimates exclude both health-related costs for which the responsibility for payment falls on the individual person with diabetes, and other government-funded health care expenses (e.g., costs for long-term care). PharmaCare implemented significant changes to its deductible structure on January 01, 2002 and on May 01, 2003.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Figure 2.20 shows the additional costs that could be avoided by reducing the incidence rate of diabetes by 25 per cent and 50 per cent. By 2015/2016, the potential savings of a 25 per cent reduction would be about $200 million dollars per year and a 50 per cent reduction would result in over $400 million dollars in annual savings. Even with these reductions, costs will continue to rise due to the increased numbers and costs of persons with diabetes as they age. However, the rate at which costs rise will be significantly reduced. Cumulatively, over the 10-year implementation period (2006/2007 – 2015/2016), a 50 per cent reduction in incidence would result in savings of over $2 billion dollars, while a 25 per cent reduction would result in savings of $1 billion.

In Summary

- In 2003/2004, there were an estimated 220,000 people (117,000 males, 103,000 females) living with diagnosed diabetes in British Columbia. Other persons with diabetes may remain undiagnosed, or undetected by the surveillance system.
- The number of persons with diabetes rises rapidly with age, peaking at the 65-69 age group for males and 70-74 for females and gradually decreasing thereafter.
- Interior Health Authority had the lowest age-standardized prevalence rate at 3.8 per cent, while Fraser and Northern Health Authorities had the highest rate at 4.8. The comparable provincial prevalence rate was 4.2 per cent.
- On average, 20,000 new cases of diabetes are diagnosed every year.
- Interior Health Authority had the lowest age-standardized incidence rate at 0.41 per cent, while Fraser and Northern Health Authorities had the highest rate at 0.50 per cent. The comparable provincial incidence rate was 0.46 per cent.
- Mortality rates among people with diabetes are twice as high as those of similar age who do not have diabetes. The majority of deaths for people with diabetes are due to diseases of the circulatory system (41 per cent), malignant neoplasms (22 per cent), diabetes (13 per cent) and respiratory diseases (9 per cent).
- Persons with diabetes are much more likely to have co-morbid conditions such as heart failure, hypertension or chronic renal disease, than persons without diabetes.
- The cost of diabetes is significant. For government-funded PharmaCare, Medical Services Plan, and hospital services, the age-adjusted cost for persons with diabetes is three times higher than for persons without diabetes.
- If the current trends in additional costs continue, the approximately $1.04 billion in costs in 2003/2004 for hospitalization, Medical Services Plan, and PharmaCare for persons with diabetes will rise to approximately $1.90 billion by 2015/2016—an increase of $900,000,000 (just over 80 per cent).
- If prevention methods are employed and the incidence of diabetes is reduced by 25 per cent, an annual savings of $200 million would result within 10 years.

Chapter 3

Diabetes Among the First Nations Population

The prevalence of diabetes among the First Nations population in Canada has increased significantly in the last 50 years. Data available for the First Nations population indicates a high prevalence of co-morbidities and complications such as heart disease, hypertension, stroke, amputations, kidney disease, and eye disease. The reason for the increasing trend in diabetes among the First Nations population could be due to the adoption of a North American diet that is high in saturated fat and simple sugars along with a sedentary lifestyle and reduced physical activity. The rate of diabetes seems to be particularly high among First Nations children and young women nationwide (Health Canada, 2000).

Traditional Foods

The traditional foods of BC's First Nations population provided a diet high in protein, low in carbohydrates, and rich in essential minerals and vitamins (Kuhnlein & Chan, 2000). In coastal communities, dried herring eggs on kelp were a favourite snack, with the eggs providing protein, calcium, iron, and thiamine. Smoked salmon and salmon eggs made a common breakfast. Local plants supplied a fresh and diverse selection of fruits and vegetables, and nuts were often added to meat stock to make tasty and nutritious soups.

At the time of colonization by Europeans, approximately one-third of Canada's native population lived in BC. The abundance of seafood available year-round made it possible for coastal tribes to settle in permanent villages, often located along the shores of sheltered bays and inlets. When the Europeans arrived, some village sites had been occupied for more than 4,000 years (Indian Affairs and Northern Development Canada, 1996). Smaller numbers of First Nations people lived in BC's Interior. Those in the Northern (Subarctic) Interior spoke Athapaskan and lived a nomadic life of hunting and gathering. Southern Interior (Plateau) First Nations travelled around the region's dry grasslands and forests in the summer, seeking seasonal food, and settled into small villages of pithouses for the winter.

An estimated 90 per cent of the dietary protein of coastal First Nations was derived from the ocean, but land animals and plants were also important sources of nutrition (Mos et al., 2004). Salmon, halibut, smelt, and herring were significant components of the traditional diet of most First Nations people who relied on salmon runs on the Fraser River and its tributaries, and throughout the Columbia River system.

Wild game, such as deer, was also another major source of protein, particularly in interior regions far from the ocean and its buffet of seafood. Studies show that wild game is healthier than farmed animal food, which has a higher fat content. Compared with the farmed animals eaten today by most consumers, most wild game has about one-half the energy (calorie/kilojoule) content and is 50 percent higher in other nutrients (Health and Welfare Canada, 1985).

HeartSmart Kids™ Aboriginal Program for Grades 4 to 6

Diabetes, stroke, and heart disease are important issues for First Nations people. The Heart and Stroke Foundation consulted with First Nations leaders and educators on these issues, and they spoke of a lack of resources for children and youth, especially regarding healthy lifestyles. Out of these consultations came a school-based resource for Grades 4 to 6 based on the HeartSmart Kids™ program.

The HeartSmart Kids™ Educator's Guide, which was sent to all First Nations schools in BC, is designed to reflect First Nations culture and values. It uses a holistic and culturally sensitive approach to teach children how to be active, eat healthy, and live smoke-free. The Guide consists of six units organized around the theme of the drum, a symbol for wholeness and health. The lessons relate to and flow out of the symbol of the drum.

In addition to the Educator's Guide, the Heart and Stroke Foundation developed a student activity book to accompany the Guide. It is a 20-page magazine with culturally appropriate activities regarding healthy eating, active living, and being tobacco-free.

So far, 65 teachers and community health nurses have attended training workshops on the use of this program. The Foundation hopes to increase the number of teachers trained in the future.

Source: Health Canada. (2004, October). *Communities act! Making change happen: Stories from British Columbia diabetes projects. (pp. 25-26)* Vancouver, BC: Health Canada.

Research over the years has found wild greens and berries to be generally higher in vitamins and minerals than cultivated plants. A wide variety of fresh fruits and vegetables were integral to the traditional First Nations diets. Seaweeds were eaten fresh or dried for the winter by coastal peoples. Cooked dandelion greens supplied vitamins A and C, as well as calcium. Wild clover roots and silverweed roots, consumed by all Coastal First Nations, were high in iron. Greens like fireweed and salmonberry sprouts supplied folic acid, vitamins A and C, and important minerals like iron, calcium, and magnesium. Altogether, 135 different kinds of plants were used as food, drinks, or flavourings in the traditional diets of BC's First Nations (Turner, 1978).

Many fats found in the traditional diet of BC's First Nations population came from fish, seeds, and nuts. These fats that are known to help reduce blood cholesterol levels, were used to bake bannock; to cook meats, fish and vegetables; and to preserve food. Some traditional fats were a key source of fat-soluble vitamins (A, D, E, and K) and a source of essential fatty acids (Health and Welfare Canada, 1985).

Many plants also made a contribution to a balanced First Nations diet. The stalks of the rhubarb plant were eaten, but the leaves, which contain toxic amounts of oxalic acid, were avoided. Blue camas bulbs provided an important source of carbohydrates in the form of a complex sugar called inulin. Along with plants, fruits such as berries were also an important part of the traditional diet. In BC, there were more than a dozen varieties including salmonberries and wild strawberries, bog cranberries, thimbleberries, and salal berries. Berries were used as a natural sweetener. All food was considered to be sacred, and ceremonies were often held to celebrate the ripening of different kinds of berries and other fruits.

First Nations traditionally had their own healthy version of today's sweetened soft drinks. Using the stems, bark, or leaves of shrubs such as wild blackberry, they brewed beverages that were consumed for pleasure or to cure illness. Tea made from the Labrador bush, a scraggly shrub with dense clusters of white flowers, was popular throughout the province. The Sliammon prepared

Labrador leaves by steaming them in a shallow pit, amidst layers of licorice fern rhizomes for flavouring, while the Haida drank Labrador tea as a medicine for sore throats and colds (Turner, 1975). Spruce bark, which has a plentiful supply of vitamin C, was boiled to make a tea that prevented scurvy.

Most food was only available seasonally, so food preservation techniques were used to ensure sufficient food in times of scarcity. Fish and game, such as deer, were smoked and dried for the lean winter months. Berries were poured into wooden frames set on skunk cabbage leaves, and placed near a fire to dry slowly for several days. Bulbs, roots, rhizomes, tree cambium and seaweed were also cleaned and dried for winter. Dried black tree lichen contained a carbohydrate that swelled when mixed with liquid, giving those who ingested it the sensation of a full belly. The lichen, also used for thickening soups, was rich in iron and was a source of calcium as well (Health and Welfare Canada, 1985).

Collecting and storing enough food for survival was a time-consuming and challenging task. It demanded constant activity and kept the First Nations population physically active and fit. Men hunted and fished together. Women worked alongside each other digging edible roots and bulbs; cleaning fish and hanging them to dry in smokehouses; collecting shellfish such as clams, oysters, and mussels; and gathering berries in the summer and fall.

Change in Dietary Traditions

The first changes in the traditional First Nations diets began to occur soon after European contact. Refined sweeteners, like sugar and molasses, became readily available. Carbohydrates, such as potatoes, flour, rice, and beans, were instantly popular amongst both Coastal and Interior First Nations groups. The consumption of traditional plant foods swiftly gave way to white man's fruits and vegetables (Turner, 1978). As industrialization and urbanization made commercial food more accessible, game meat was replaced by store-bought meat, natural foods by processed foods, and traditional beverages by pop, juice, and alcohol.

For millennia, First Nations people had been sustained by the diverse harvests of the nearby land, ocean, rivers and lakes. Suddenly, over the course of a few decades, the traditional diet virtually vanished and a western diet was almost universally adopted. Instead of fresh, local fare, commercial foods produced elsewhere were consumed. Furthering the loss of the traditional diet, the establishment of residential schools separated children from their families and communities, hindering the custom of passing down traditional food knowledge from generation to generation. Other factors such as commercial traplines, unsustainable forestry, industrial pollution and fish farming may have also contributed to the loss of the traditional diet. Lifestyles also became far more sedentary after First Nations reserves were established, contributing to risk factors for disease.

The amount of carbohydrates consumed by BC's First Nations groups was very limited prior to the introduction of sugar, potatoes, wheat, and other starchy foods. Following European contact, flour and sugar soon became prominent features in the First Nations diet, and were used in a variety of bread, bannock, cakes, and cookies.

Today, market food comprises the bulk of First Nations diets. Across Canada, only about 15 percent of First Nations people still obtain most of their animal proteins from hunting and fishing (Young, Reading, Elias, & O'Neil, 2000). For the most part, nutrient-rich traditional plant foods are no longer gathered for barter or sale, although some First Nations still collect them to share with friends and family (Turner, 1978). Many fish and shellfish, however, continue to represent an important source of nutrition and culture for BC's First Nations Peoples (Mos et al., 2004). One study of the Nuxalk Nation found that, with the exception of fish, very little traditional foods were still consumed (Hans, Hilland, & Kuhnlein, 2003).

Generally, the western diet embraced by a vast majority of BC's First Nations today is far less healthy than a traditional diet since it represents an increase in calories, carbohydrates, total fat, and saturated fat intakes (Mos et al., 2004, Kuhnlein & Chan, 2000). It is also lower in

nutrients than traditional food, and is thought by some researchers to have contributed to chronic diseases such as diabetes among First Nations peoples (Turner and Ommer, 2003). The combination of the western diet high in carbohydrates, simple sugars and fats and a sedentary, inactive lifestyle has more than likely contributed to the epidemic of diabetes among the First Nations population.

Terminology

The terminology used to refer to indigenous populations in Canada has varied over the years. It is therefore important to understand the origin and definition of these terms. Aboriginal peoples are the descendants of the original inhabitants of North America. The *Constitution Act* recognizes three groups of First Nations people: Indian, Inuit, and Métis people. First Nations has replaced the term Indian as the terminology preferred by many Indian people in Canada, although "Indian" is still used where referring to legislation or governments statistics.

First Nations people are often considered to be members of a First Nation band or tribe. First Nations is not a legally defined term and refers to both Status Indians and non-Status Indians. Status Indians are those who are entitled to receive benefits under the provisions of the *Indian Act*. Non-Status Indians are those who do not meet the criteria for registration or who have chosen not to be registered.

The Métis population are people of mixed First Nation and European ancestry who identify themselves as Métis, as distinct from Indian people, Inuit, or non-Aboriginal peoples. Most Métis people live in the three Prairie provinces. Unlike Status Indians and Inuit, the Métis are not eligible for programs provided under the *Indian Act*.

According to Canada Census 2001 figures, the number of Aboriginal peoples in BC was 170,025 in 2001. Of these individuals 118,290 were Status Indians, 44,270 were Métis, 805 were Inuit,[1] and 6,660 were considered as other (BC Stats, 2001). For the purpose of this report, the Status Indian population was estimated to be 147,000 persons as of 2003/2004 (see Appendix C for Status Indian population methodology). This number is larger than the 2001 estimate and is considered to be more current and accurate (i.e., census is self-reported data).

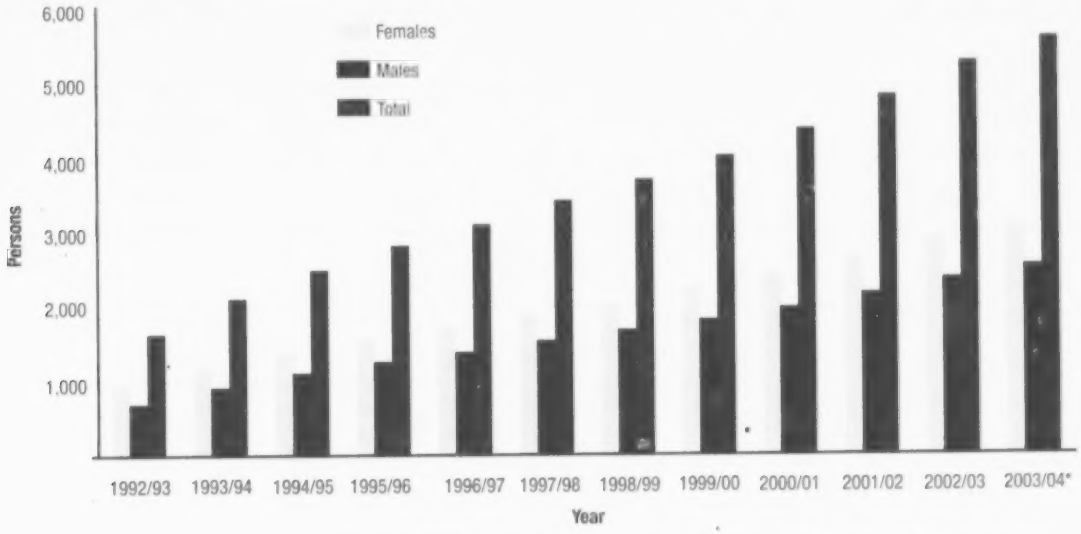
Availability of Data

Although there is considerable interest in the health status of all Aboriginal peoples (the Métis, non-status and Inuit), in most cases, relevant data is only available for Status Indians. Information to identify Status Indian data in this report was obtained from the British Columbia Vital Statistics Agency, British Columbia Medical Services Plan, and the First Nations and Inuit Health Branch of Health Canada (British Columbia Vital Statistics Agency, 2004). For further details of data sources and methodologies, please consult Appendix C.

[1] *Inuit, meaning "the people" in Inuktitut language inhabit Nunavut, the Northwest Territories, the coast of northern Labrador, and parts of Quebec (Indian and Northern Affairs Canada, 2000). Approximately 805 Inuit lived in BC based on Canada Census 2001 figures (BC Stats, 2001).*

Prevalence of Diabetes Among the Status Indian Population in British Columbia

Figure 3.1 Prevalence of Diabetes, Status Indians, BC, 1992/1993 to 2003/2004



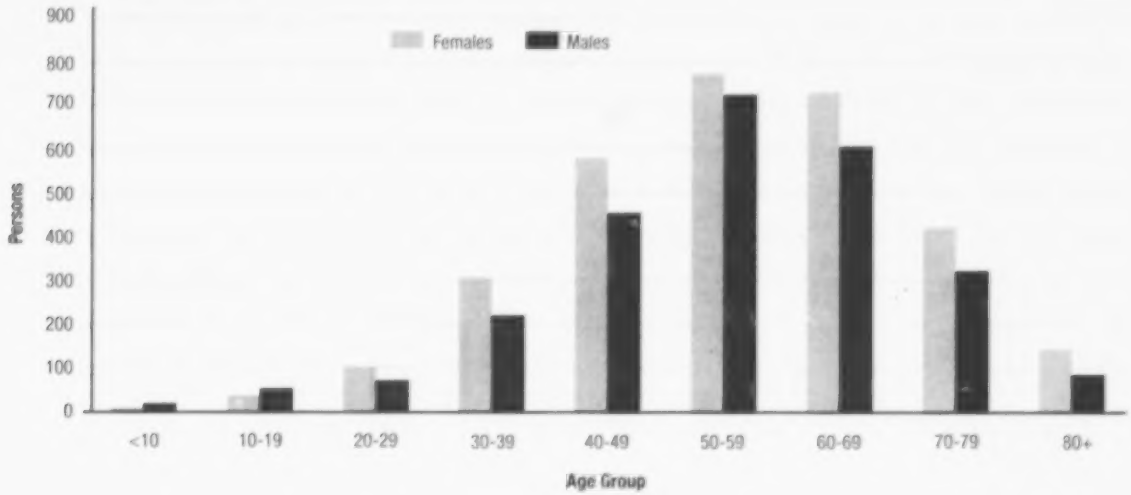
*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of MSP component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"At the end of the fiscal year 2003/2004, there were an estimated 5,600 Status Indians living with diabetes in British Columbia."

The prevalence of diabetes is defined as the number, expressed as a rate, of diabetes cases within a population during a fiscal year. At the end of fiscal year 2003/2004, there were an estimated 5,600 Status Indians (3.8 per cent) living with diabetes in BC (Figure 3.1): approximately 3,100 (4.1 per cent) females and about 2,500 males (3.6 per cent). Because 3.8 per cent is a crude prevalence, it does not take differing age structure of the Status Indian population into consideration. This under recognizes the occurrence of diabetes in the Status Indian population (see Figure 3.4 for age-standardized prevalence comparisons).

Figure 3.2a Age Distribution of Status Indians With Diabetes, BC, 2003/2004*



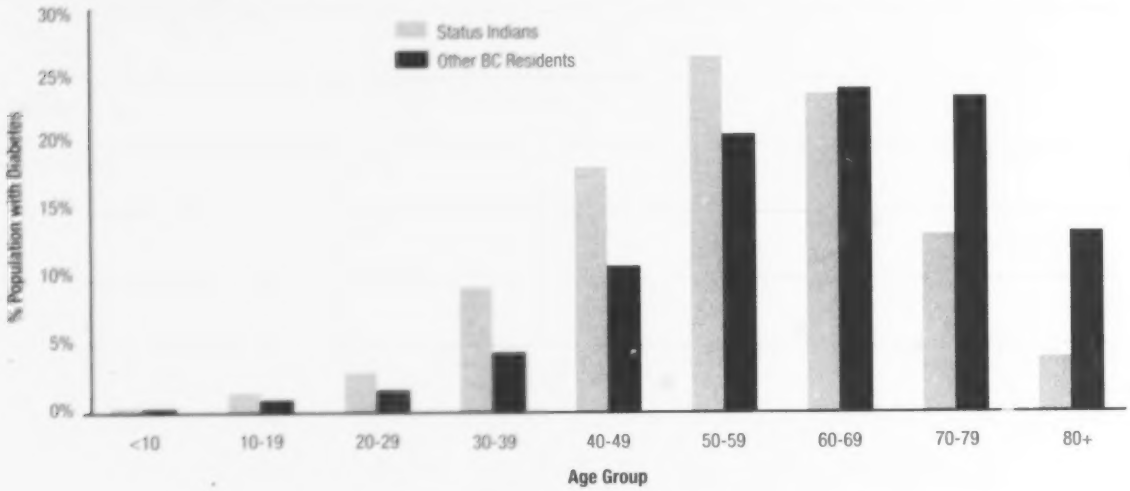
*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of MSP component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"In 2003/2004, females outnumbered males in most age groups except for those 19 and under."

Females outnumber males in most age groups except for those 19 and under (Figure 3.2a). The number of cases rises rapidly with age to 50-59 years and then declines sharply in the older age groups.

Figure 3.2b Age Distribution of Diabetes, Status Indians and Other BC Residents, BC, 2003/2004*



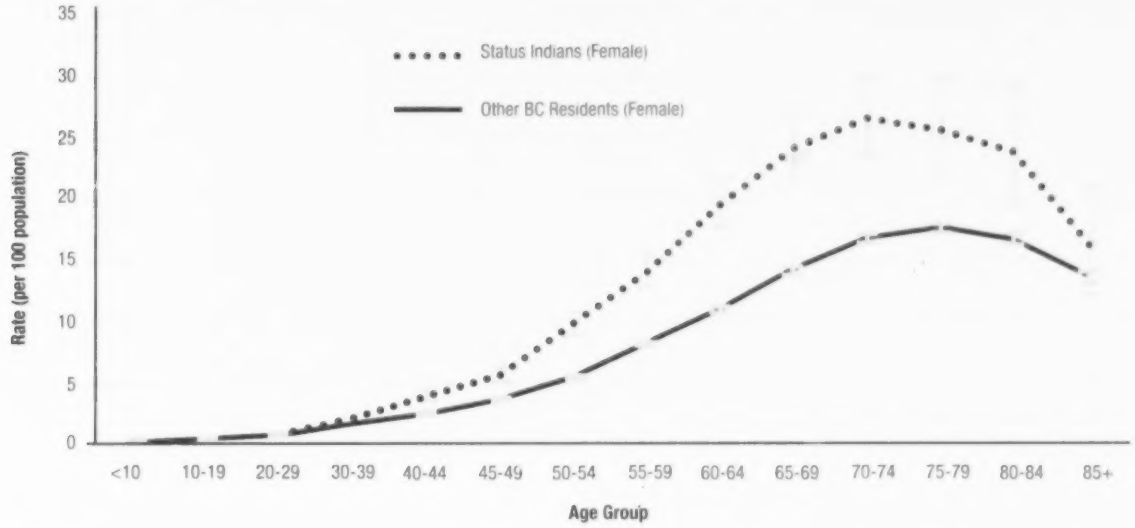
*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of MSP component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"Compared to other BC residents, Status Indians have a higher proportion of cases of diabetes in the age groups under 60 years of age."

The distribution of diabetes cases by age differs in Status Indians and other BC residents. Status Indians have a higher proportion of cases of diabetes in the age groups under 60 years of age, while other BC residents have higher proportions in ages 70 years and older.

Figure 3.3a Age-Specific Prevalence Rate of Diabetes, Female, Status Indians and Other BC Residents, BC, 2003/2004*



*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of MSP component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"Prevalence of diabetes increases with age, rising substantially after age 40 for both males and females."

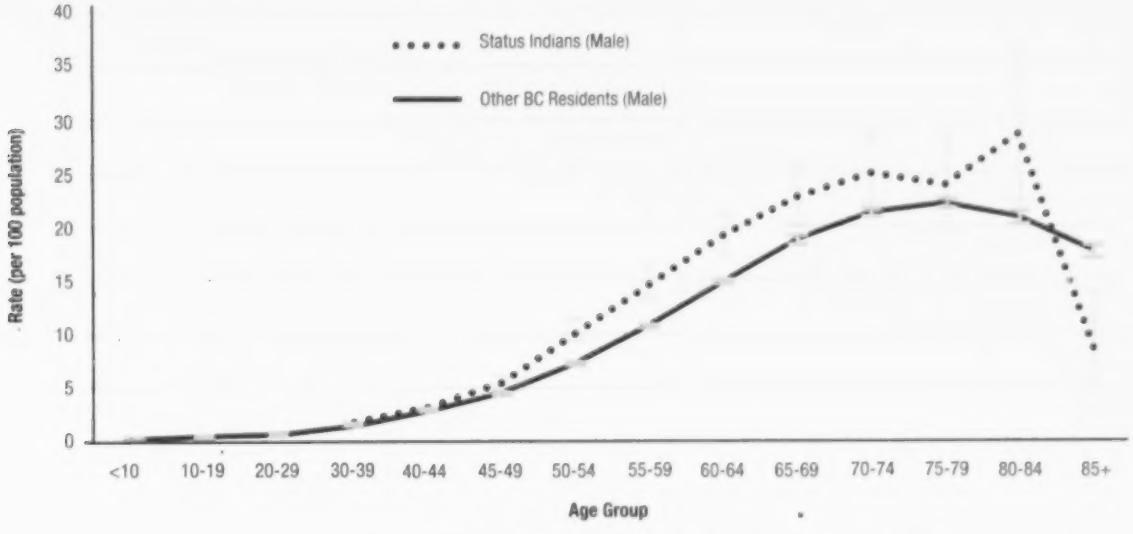
Figures 3.3a and 3.3b show the female and male prevalence of diabetes by age for Status Indians and other BC residents for 2003/2004, with the associated 95 per cent confidence intervals (CI).[2] The prevalence of diabetes increases with age, rising substantially after age 40 for both females and males in both populations. Small numbers for Status Indian males in age groups 80+ result in data instability as seen in Figure 3.3b.

Among Status Indians, male and female prevalence rates are similar in most age groups. This contrasts with other BC residents where male rates are generally higher. Status Indians experience higher rates of diabetes in most age groups and this is particularly evident for females where rates are significantly higher than other BC residents.

[2] *Confidence interval (CI) is described as the range of values within which a population parameter is estimated to lie. For a 95 per cent confidence interval, we expect the true value to be within the stated range 19 times out of 20. For example, if the prevalence rate in a population is stated as 5.2 per cent with a 95 per cent CI of 4.9 (lower) and 5.5 (upper), we would expect the true prevalence rate in the population to lie between 4.9 and 5.5 with only a 1 in 20 chance that it is not between the two values. Confidence intervals are represented by (I) on the figures throughout this report.*

Figure 3.3b

Age-Specific Prevalence Rate of Diabetes, Male, Status Indians and Other BC Residents, BC, 2003/2004*



*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of MSP component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Lil'wat Diabetes Prevention Program

Mount Currie Health Centre in Mount Currie, British Columbia, has a very active and multi-functional diabetes prevention program. In the last two years, they have created an exercise program, housed in "Neighborhood House." Over time, they accumulated a variety of equipment, and began their program with three exercise classes a week, open to all diabetics in the community and elders. One of the classes includes a healthy lunch. Clients monitor their progress on a chart, which encourages them to continue to exercise. In this setting, organizers provide education on healthy eating and physical activity, and information on diabetes self-management. Blood sugar levels are taken before and after exercising, and the community health nurse monitors clients' blood pressure, weight, and body mass index on a monthly basis.

The exercise programs at Neighborhood House have continued to expand, especially into the area of youth physical activity. Currently, there are 19 exercise groups happening per week, and they are available to all community members (except small children). The Health Centre received funding for five members of the community to study on-line personal fitness and training, with the goal to have five personal trainers that can teach other members of the community to become physically fit.

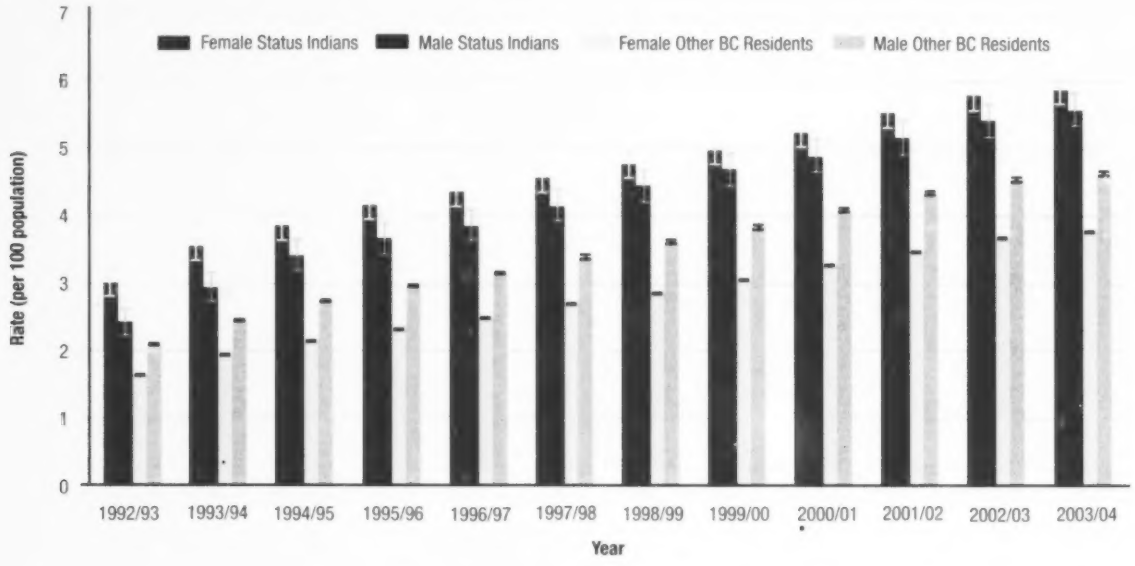
In addition to the exercise groups at Neighborhood House, there is a weekly swim group, and a walking group (The Moccasin Miles Walking Club). The walking group members meet 3 times per week for 13 weeks, with the end goal to be able to walk/run 10 kilometres. They have also utilized pedometers to record the number of steps people take per day.

The diabetes prevention program also utilizes the Health Centre's community kitchen. A dietitian/nutritionist comes to the community from Kelowna twice a year to give workshops on healthy eating/lifestyle, cooking demonstrations, and individual counselling. On her last visit in February 2005, she worked with staff at the local store and gas station on providing healthier food choices to the community. Both the store and gas station were receptive to her suggestions.

There is also a weekly support group for people with diabetes, to give emotional support to help people deal with diabetes, diabetes self-management, denial, and why they may not be making healthy lifestyle choices. The group will use a talking circle, and if funding is available, may expand to include a healthy lunch or snacks. The latest goal of the prevention program is to go into the community school and work with teachers to provide a curriculum that teaches healthy lifestyle and diabetes prevention. They are working with the school to support their present Breakfast Program, and a "NO POP" challenge, where students and their families are challenged to be "pop-free" for one month.

Source: T. Williams and A. Samuels, personal communication, March 9, 2005.

Figure 3.4 Age-Standardized Prevalence Rates, Status Indians and Other BC Residents, BC, 1992/1993 to 2003/2004*



*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of MSP component of the incident case definition. Trends for all populations are statistically significant ($p < 0.001$).

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"The 2003/2004 age-standardized diabetes prevalence rate for Status Indians was about 5.7—approximately 40 per cent higher than other BC residents."

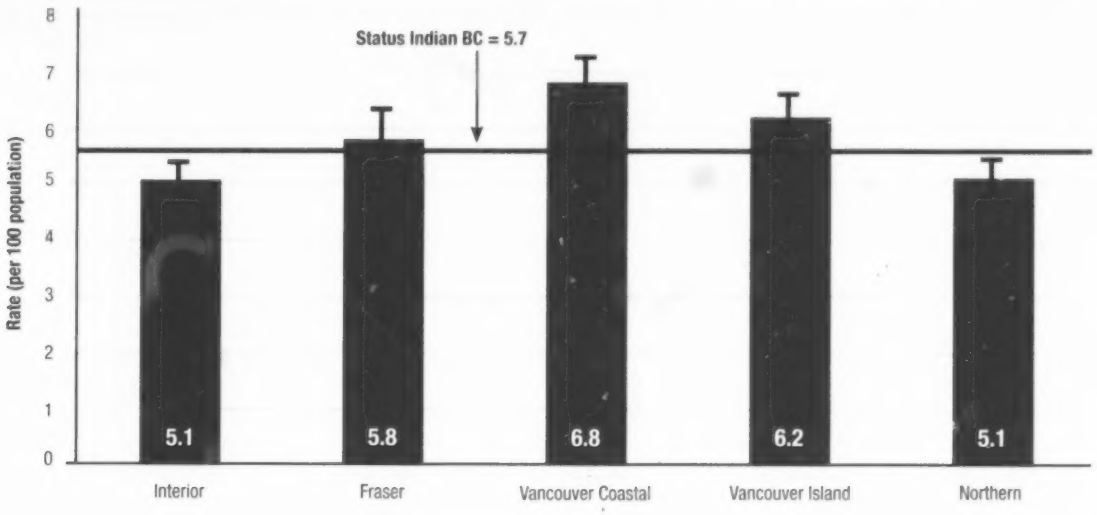
To compare overall rates for males and females in both the Status Indian and other BC residents populations, it is necessary to adjust for differences in age structure (age-standardize). In 2003/2004, the age-standardized diabetes prevalence rate was 5.6 per cent for males and 5.9 per cent for females in the Status Indian population. For other BC residents, the prevalence rate was 4.7 per cent for males and 3.8 per cent for females. Female rates are greater than male rates in the Status Indian population. This is a reversal of the pattern seen in other BC residents.

Prevalence rates (age-standardized) for both Status Indian and other BC residents have been significantly increasing over time. This is true for males and females in both populations.

Status Indian prevalence rates are approximately 40 per cent higher than those for other BC residents. The gap between Status Indian females and other BC resident females is substantially larger than that for males.

Figure 3.5a

Age-Standardized Prevalence Rate of Diabetes, Status Indians, by Health Authority, 2003/2004*



*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of MSP component of the incident case definition.

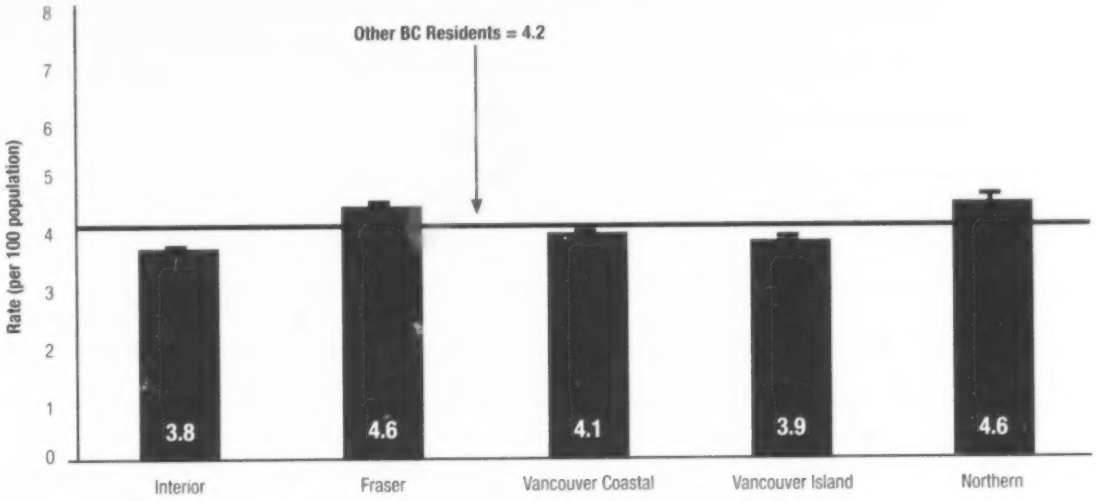
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"The age-standardized prevalence rate of diabetes for Status Indians is higher than other BC residents in all Health Authorities."

Age-standardized prevalence rates range from a low of about 5 per cent in Interior Health Authority and Northern Health Authority to a high of nearly 7 per cent in Vancouver Coastal Health Authority. Prevalence rates for other BC residents are significantly lower in all Health Authorities. The largest differences are in Vancouver Coastal and Vancouver Island Health Authorities.

Figure 3.5b

Age-Standardized Prevalence Rate of Diabetes, Other BC Residents, by Health Authority, 2003/2004*



*Cases for 2003/2004 are adjusted to compensate for incomplete follow-up (12 months) of MSP component of the incident case definition.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Aboriginal Diabetes Initiative

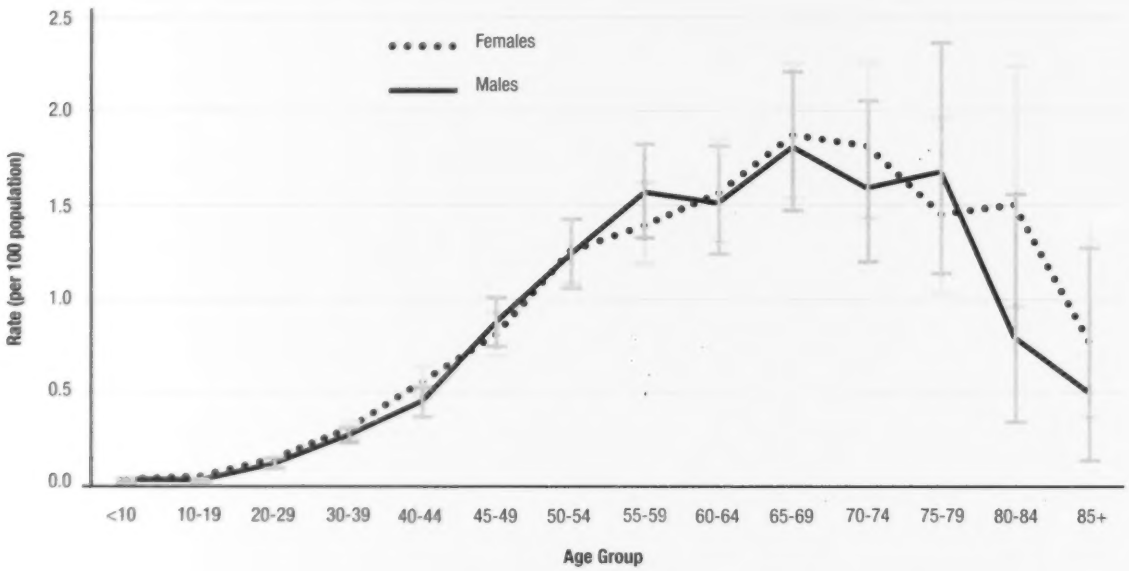
Health Canada's Canadian Diabetes Strategy was created in 1999, as a five-year program to begin to deal with the issue of diabetes. The Aboriginal Diabetes Initiative is a component of this strategy. The Aboriginal Diabetes Initiative is designed to provide a comprehensive, collaborative, and integrated approach to decreasing diabetes and its complications among Aboriginal peoples. The program is overseen by a national steering committee with representatives from the national Aboriginal organizations, as well as the National Aboriginal Diabetes Association. The Initiative has been developed in partnership with Aboriginal people. Programs emphasize holistic, culturally appropriate approaches. Aboriginal people are involved in all stages of development, implementation, and program maintenance.

The Aboriginal Diabetes Initiative currently funds 51 projects in BC, providing services to about 135 Bands (this is approximately 70 per cent coverage, as there are a total of 198 Bands in BC). The project funding through the initiative for these 51 projects is over $1 million (P. Morrison, personal communication, February 7, 2005). In October 2005, the federal government announced that an additional $55 million will be devoted to the continuation of this project.

Source: Health Canada, First Nations and Inuit Health Branch. (2003, June 3). *Aboriginal Diabetes Initiative.* Retrieved February 21, 2005, from http://www.hc-sc.gc.ca/fnihb-dgspni/fnihb/cp/adi/introduction.htm

Incidence of Diabetes Among the Status Indian Population in British Columbia

Figure 3.6a Age-Specific Incidence Rate of Diabetes, Status Indians, BC, 1998/1999-2002/2003*



*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

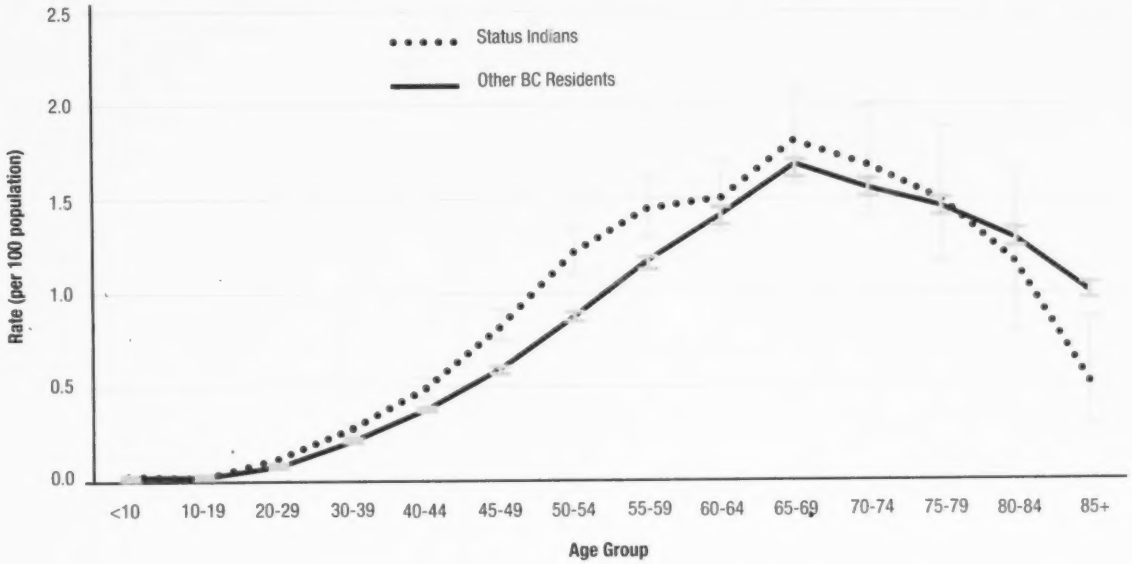
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"From 1998/1999 to 2002/2003, about 2,600 new cases of diabetes among Status Indians were identified—approximately 520 new cases per year."

Incidence measures the number, or rate, of newly diagnosed cases of diabetes in the population. Over the 5-year period—1998/1999-2002/2003—about 2,600 new Status Indian cases were identified—approximately 520 new cases per year, on average. Incidence rates rise steeply from ages 40-44 and peak at ages 65-69 (Figure 3.6a). Male and female incidence rates are similar, but because the population contains more females than males, about 125 females are diagnosed for every 100 males. The age-specific incidence rates are significantly higher among Status Indian in ages 30 through 59 when compared to the other BC residents population (Figure 3.6b).

Figure 3.6b

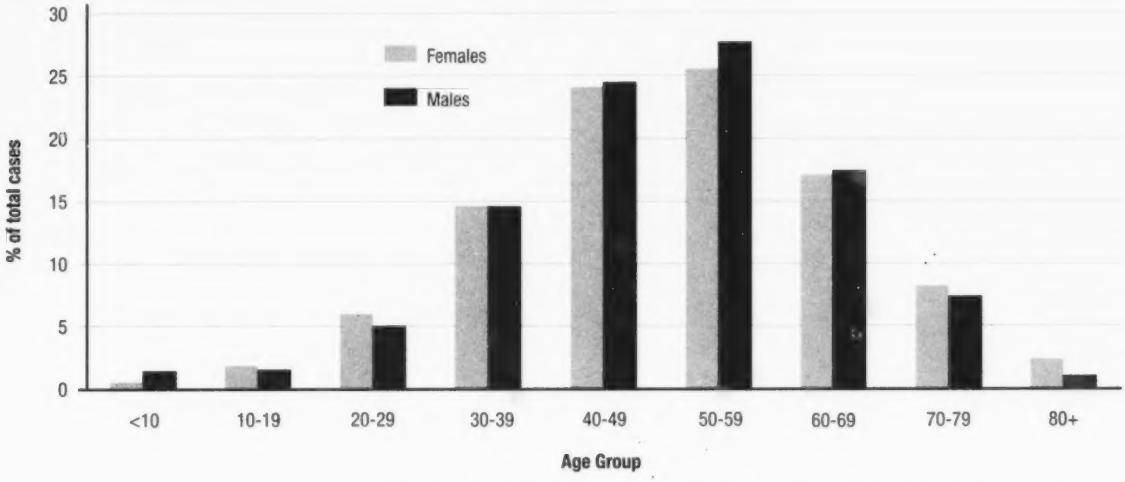
Age-Specific Incidence Rate of Diabetes, Status Indians and Other BC Residents, BC, 1998/1999-2002/2003*



*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Figure 3.7a Distribution of All Incident Diabetes Cases by Age Group, Status Indians, BC, 1998/1999-2002/2003*



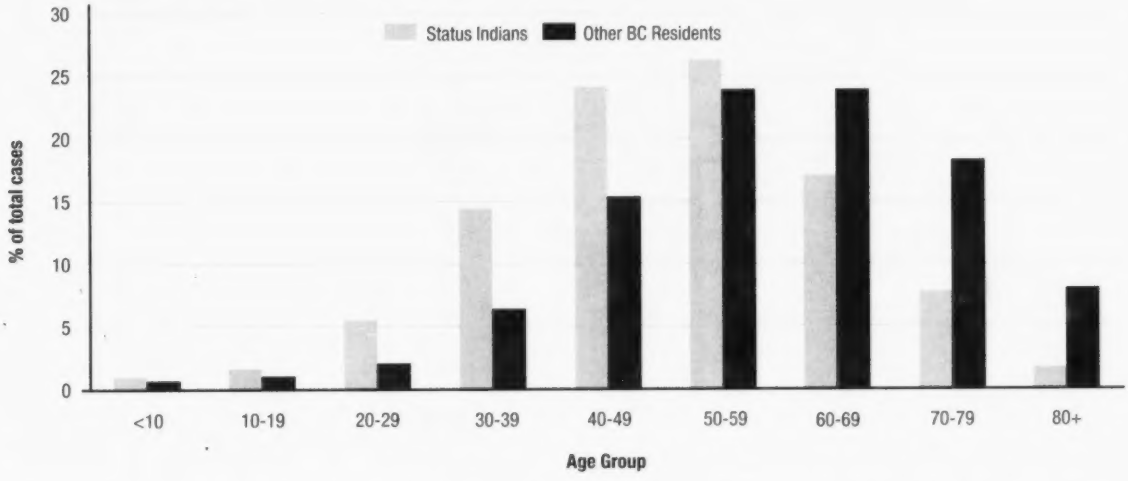
*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"Among the Status Indian population, males and females show a similar distribution of diabetes incident cases."

Figure 3.7a shows the distribution of all incident diabetes cases by age group for Status Indian population. Males and females show a similar distribution of incident cases.

Figure 3.7b Distribution of All Incident Diabetes Cases by Age Group, Status Indians and Other BC Residents, BC, 1998/1999-2002/2003*



*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

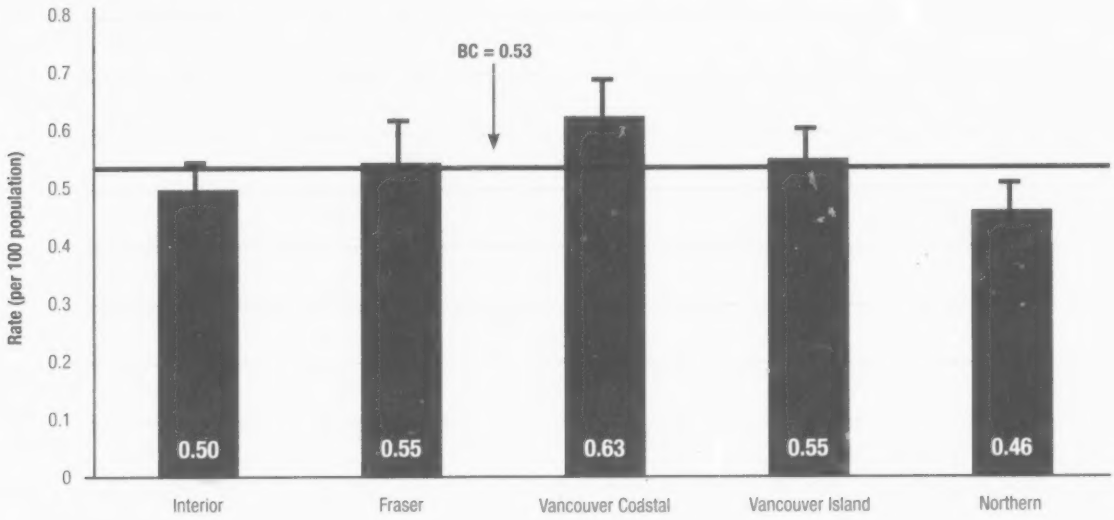
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"About 50 per cent of newly diagnosed Status Indian diabetes cases are under 50 years of age compared to 25 per cent for other BC residents."

The distribution of newly diagnosed cases of diabetes among Status Indians occurs more frequently in the younger age groups compared to other BC residents.

About 50 per cent of newly diagnosed Status Indian diabetes cases are under 50 years of age, compared to 25 per cent for other BC residents. Only 27 per cent of new Status Indian cases are 60 years and older, compared to 45 per cent of other BC residents. The higher incidence of diabetes at earlier ages among Status Indians is of concern, as this results in a greater life-time risk of diabetic complications.

Figure 3.8a Age-Standardized Incidence Rate of Diabetes, Status Indians, by Health Authority, 1998/1999-2002/2003*



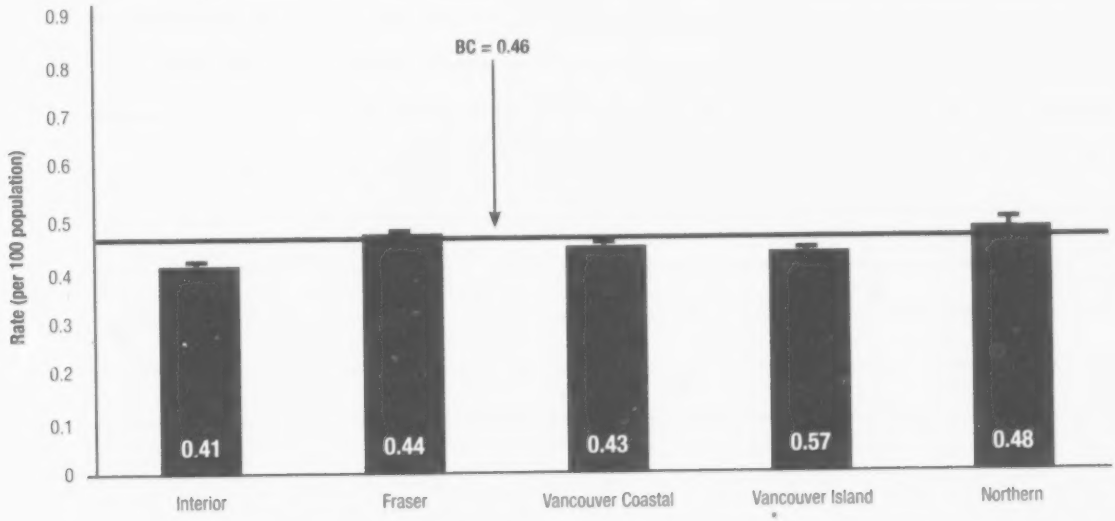
*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"Vancouver Coastal Health Authority had the highest age-standardized incidence rate of diabetes at 0.63 per cent. Northern Health Authority had the lowest rate at 0.46 per cent."

Age-standardized incidence rates among all Health Authorities range from a low of about 0.46 per cent in the Northern Health Authority to a high of 0.63 per cent in the Vancouver Coastal Health Authority (Figure 3.8a). The Northern Health Authority is notably lower than the BC rate for Status Indians, while the Vancouver Coastal Health Authority is notably higher.

Figure 3.8b Age-Standardized Incidence Rate of Diabetes, Other BC Residents, by Health Authority, 1998/1999-2002/2003*



*Note: New cases of diabetes arise sporadically and create volatility in the yearly incidence rates for individual age groups. For this reason, a 5-year period is used to smooth out fluctuations that may arise.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Age-standardized incidence rates for other BC residents are generally lower than those for Status Indians. The largest difference is in the Vancouver Coastal Health Authority where the Status Indian rate is over 40 per cent higher. Status Indian rates are also higher in the Interior, Fraser, and Vancouver Island Health Authorities, but not substantially different in the Northern Health Authority.

Aboriginal Diabetes Awareness, Prevention and Teaching Program

The Aboriginal Diabetes Awareness, Prevention and Teaching (ADAPT) program is provided by the Vancouver Native Health Society. The Society's mission is "to improve and promote the physical, mental, emotional and spiritual health of individuals, focusing on the Aboriginal community residing in Greater Vancouver." (Vancouver Native Health Society, About the Society, 2003). ADAPT's goal is to raise awareness of and prevent diabetes among Aboriginal residents of Vancouver's Eastside through a culturally and community appropriate approach. ADAPT is staffed by a dietitian and Aboriginal Elder Resident.

ADAPT offers a variety of activities which promote healthy eating and active living to prevent and manage diabetes. These activities include a community kitchen; sharing circles; twice monthly drop-in meetings regarding holistic health; and free workshops on diabetes prevention and management, traditional foods, nutrition, and healthy eating on a budget.

Thousands of Aboriginal individuals have been able to take part in ADAPT's activities. They have created a safe environment, where people can share their personal stories about diabetes, and act as role models and leaders for others. As a result, many people have adopted healthy habits. This success is remarkable, given the economic and social challenges in Vancouver's Eastside.

Sources: Vancouver Native Health Society. (2003). *Aboriginal Diabetes Awareness, Prevention and Teaching.* Retrieved February 2, 2005, from www.vnhs.net/programs/diabetes.htm

Vancouver Native Health Society. (2003). *About the Society – Overview.* Retrieved February 2, 2005, from www.vnhs.net/about.htm

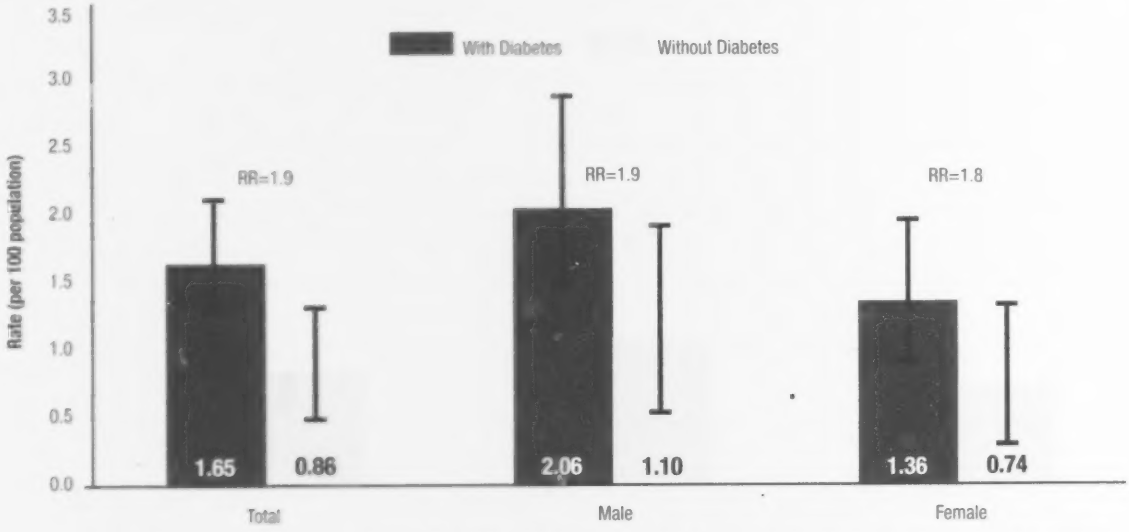
Haida Gwaii Diabetes Project

The Haida Gwaii Diabetes Project in the Queen Charlotte Islands began as family physicians and the First Nation community began to notice an increase in the incidence of Type 2 diabetes in their community. Phase 1 of the project involved a study of the medical charts of all those who had Type 2 diabetes to develop a bio-physical profile. Phase 2 involved an invitation to all those diagnosed with Type 2 diabetes to clinics staffed with local physicians, nurses, and project directors. During the meetings at the clinics, the individuals met with program directors and had their weight, height, blood pressure, resting pulse, and fasting blood sugar recorded. Other information regarding smoking, alcohol, level of education, exercise, and medication was also recorded. Finally, a questionnaire was provided to determine the best formats of learning. Phase 3 of the program involved focus groups, brought together to discuss the meaning of diabetes, living with the illness, and ideas about prevention. The concepts of traditional foods and exercise programs were also introduced.

Although participation in this project was not very high, a significant decrease in total cholesterol and weight among participants was seen. In addition, the study findings were used to develop a culturally sensitive approach to prevention and management of diabetes in the community. Finally, the project developed a list of issues with a wide range of implications for intervention including use of traditional food and medicines, exercise, as well as acknowledging historical and political issues (Queen Charlotte Islands Health Care Society & University of British Columbia, 1996, p.122).

Mortality and Diabetes Among the Status Indian Population in British Columbia

Figure 3.9a Age-Standardized Mortality Rates, Status Indians With and Without Diabetes, BC, 1998/1999-2002/2003



* Note: Figure 3.9a and Table 3.1 present rate ratios based on different data over different time periods and using different age groupings for the underlying age-standardized mortality rates. As such, the rate ratios may not be directly comparable. Figure 3.9a is using probabilistic linkage to overall death counts, age-standardized mortality rates, and rate ratios over a 5-year period (age-standardized using 14 age groups). Table 3.1 is using deterministic linkage to cause of death counts, age-standardized mortality rates, and rate ratios over a 12-year period (age-standardized using three age groups). Age-standardized mortality rate (ASMR) per 10,000 and rate ratio with 95 per cent confidence interval (CI).

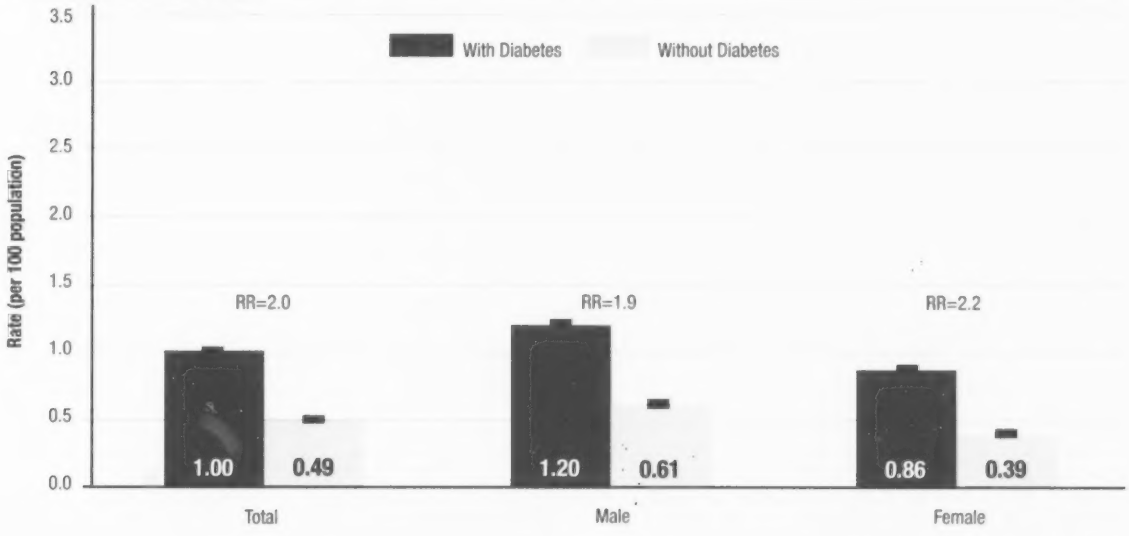
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"The Status Indian population with diabetes have mortality rates that are about two times higher than those without diabetes."

Over the 5-year period 1998/1999 to 2002/2003, the Status Indian population with diabetes (males, females, and total), had mortality rates that were about two times higher than those without diabetes (Figure 3.9a).This is similar to the pattern for other BC residents; however, mortality rates are higher for both Status Indians with diabetes and without diabetes when compared to both groups of other BC residents.

Figure 3.9b

Age-Standardized Mortality Rates, Other BC Residents With and Without Diabetes, BC, 1998/1999-2002/2003

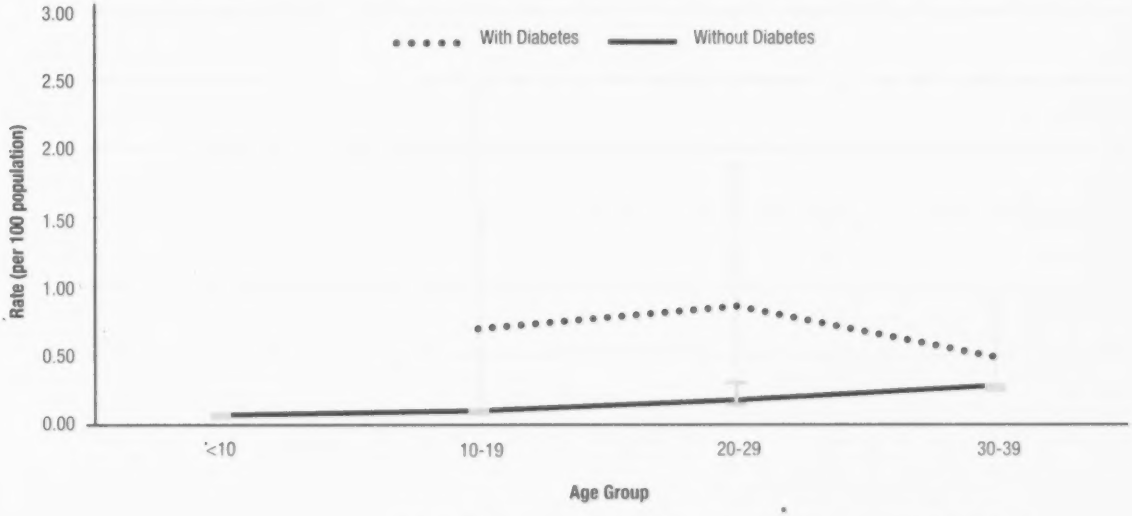


Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Mortality rates for Status Indian males with and without diabetes are about 50 per cent higher than the rates for Status Indian females. While rates are lower for both males and females in the population of other BC residents, male rates are also substantially higher than rates for females.

Figure 3.10a

Age-Specific Mortality Rates, Ages < 10 to 39 years, Status Indians With and Without Diabetes, BC, 1998/1999-2002/2003



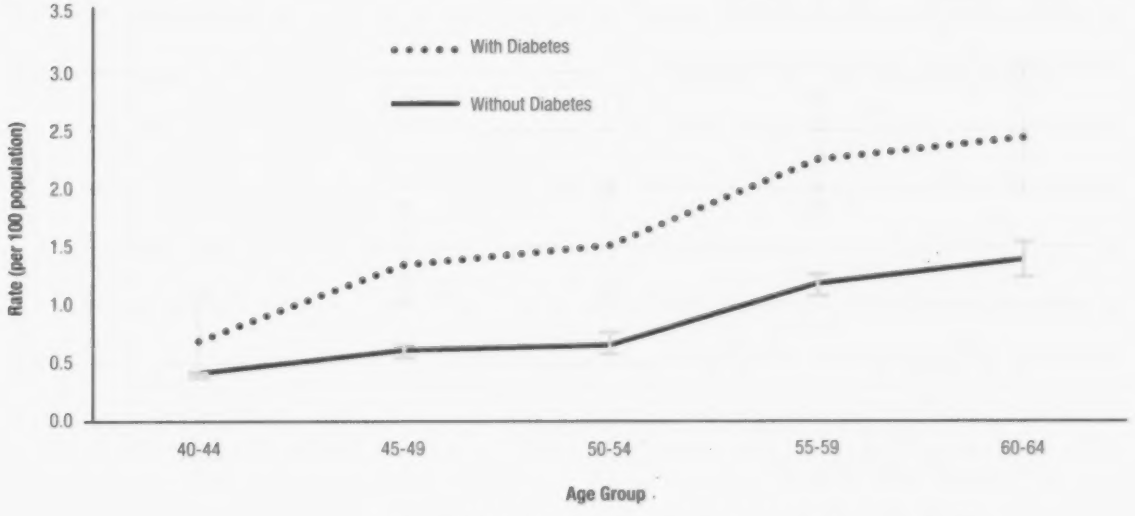
Note: No deaths for persons with diabetes were recorded for those under 10 years of age.

Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

On average, more than 100 Status Indians with diabetes die every year in British Columbia. Mortality rates are higher among Status Indians with diabetes when compared to Status Indians without diabetes across all age groups (Figures 3.10a-c). This pattern is mirrored among other BC residents, but it is evident that mortality rates are significantly lower for all age groups for other BC residents when compared to the Status Indian population (Figures 3.10d-f). It is important to note that for the Status Indian population, age groups less than 30 years of age contain extremely small numbers of deaths of persons with diabetes, compared to other age groups. This has resulted in larger confidence intervals around mortality rates (Figure 3.10a).

Figure 3.10b

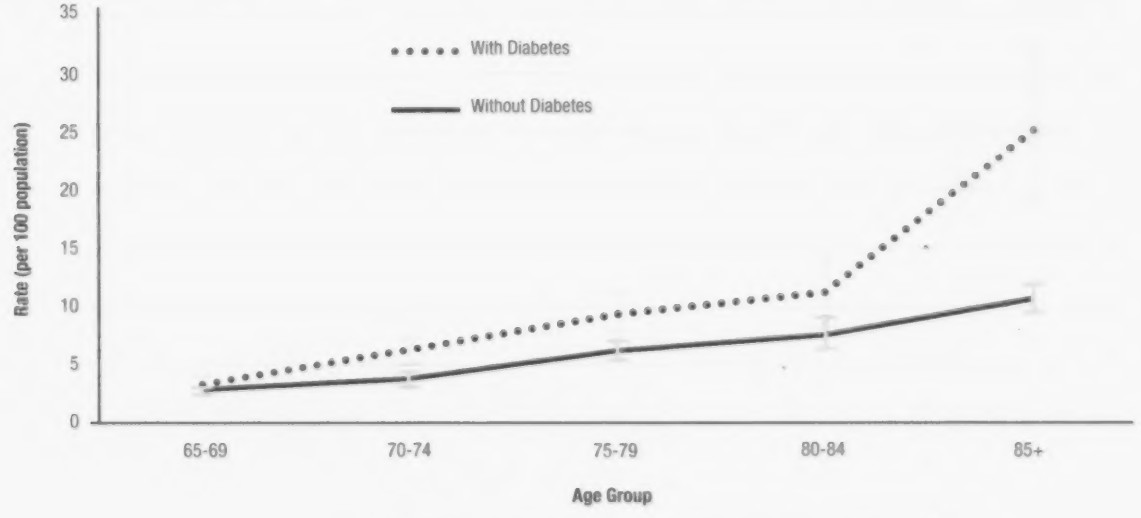
Age-Specific Mortality Rates, Ages 40 to 64 years, Status Indians With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

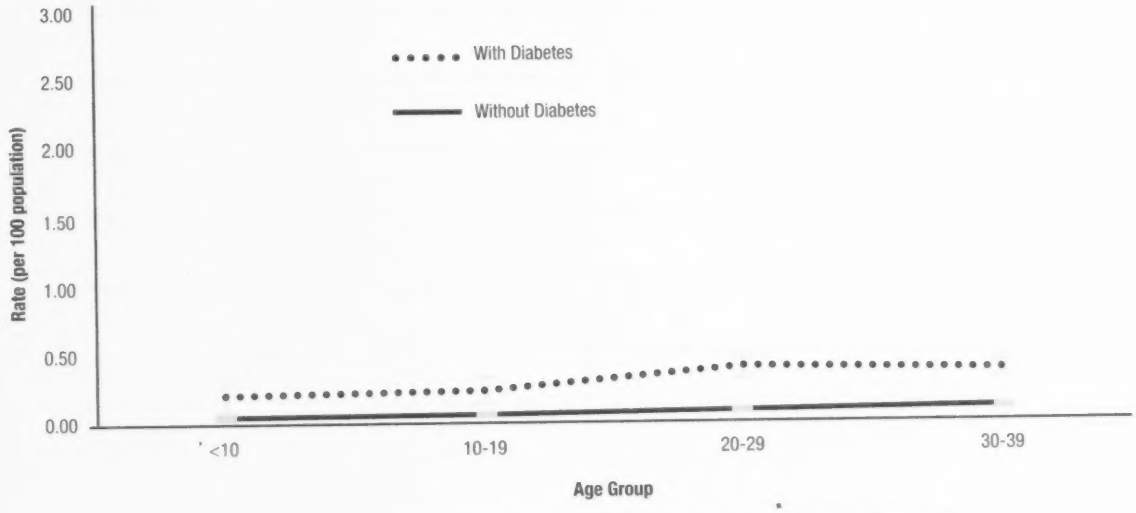
Figure 3.10c

Age-Specific Mortality Rates, Ages 65 to 85+ years, Status Indians With and Without Diabetes, BC, 1998/1999-2002/2003



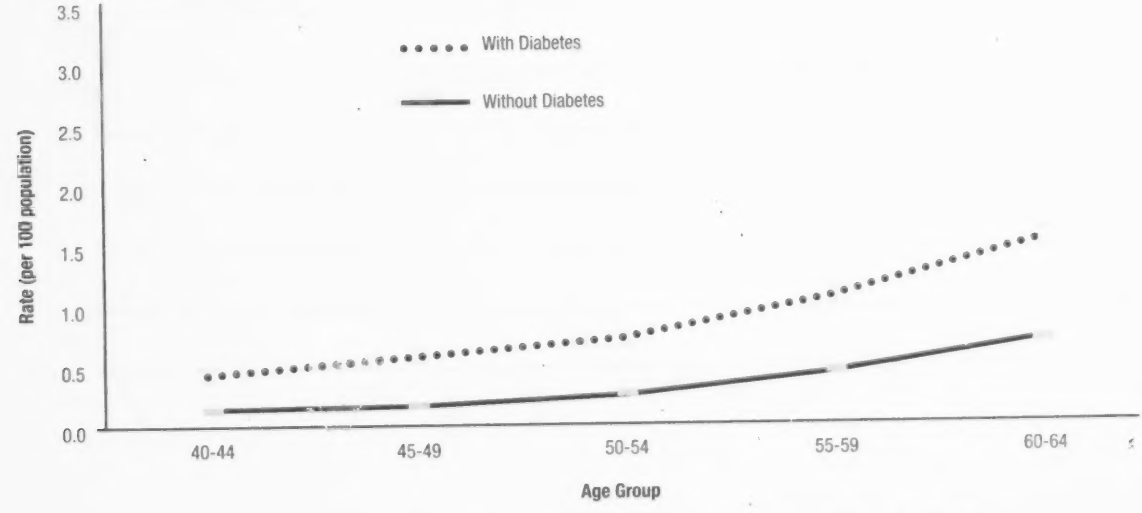
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Figure 3.10d Age-Specific Mortality Rates, Ages < 10 to 39 years, Other BC Residents With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

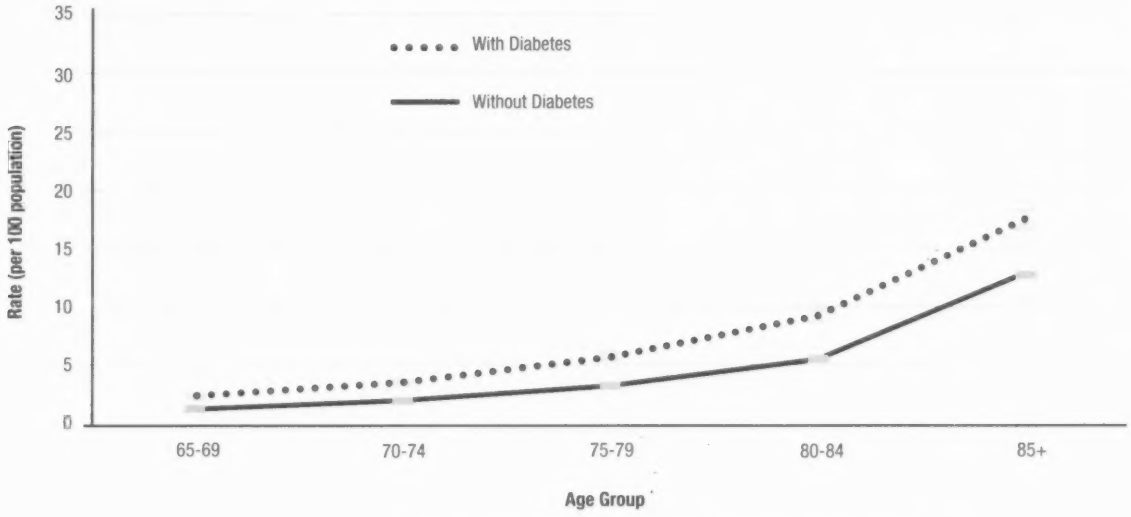
Figure 3.10e Age-Specific Mortality Rates, Ages 40 to 64 years, Other BC Residents With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Figure 3.10f

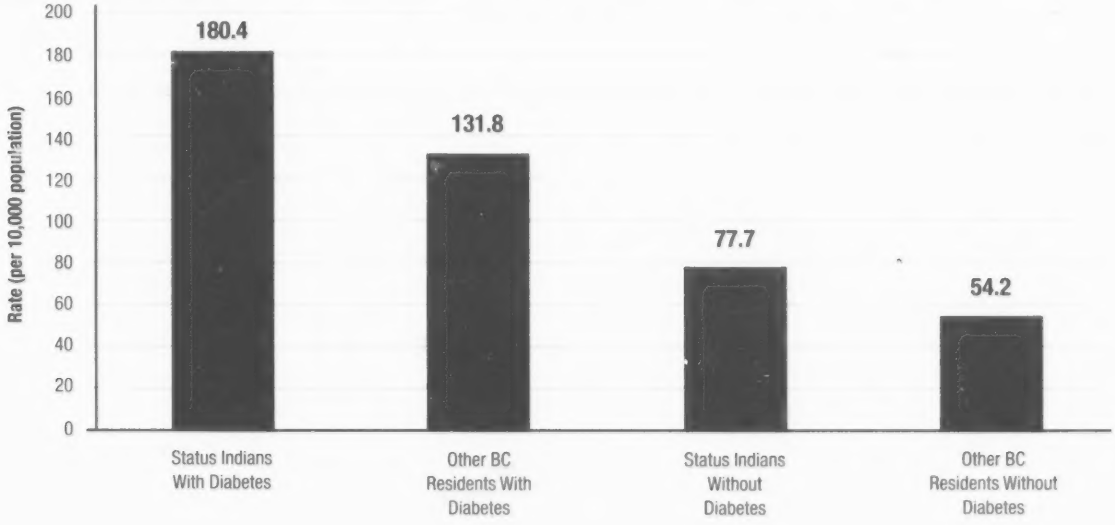
Age-Specific Mortality Rates, Ages 65 to 85+ years, Other BC Residents With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Figure 3.11

Age-Standardized Mortality Rates, Status Indians and Other BC Residents With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Detailed Cause of Death Comparison

Overall Mortality

In general, people with diabetes have higher mortality rates when compared to those who do not have diabetes. This is true for both Status Indians and other BC residents. Unfortunately, mortality rates among Status Indians are higher than rates for other BC residents for both Status Indians with diabetes and Status Indians without diabetes. Comparing specific causes of death over the 12-year time period 1992/1993 to 2003/2004 shows that Status Indians with diabetes have an elevated risk (2.3 times) of dying from all causes of death when compared to Status Indians without diabetes. The all causes age-standardized mortality rate was 180.4 and 131.8 (per 10,000 population) for Status Indians and other BC residents with diabetes respectively. The Status Indians and other BC residents without diabetes have age-standardized mortality rates of 77.7 and 54.2 per cent respectively (Figure 3.11). When compared to other BC residents, overall mortality rates for Status Indians with and without diabetes are about 40 per cent higher.

Major Causes of Death

Table 3.1 shows age-standardized mortality rates with comparisons between Status Indians with diabetes and without diabetes. The majority of deaths of persons with diabetes are due to four broad causes: Diseases of the circulatory system (36 per cent), malignant neoplasms (17 per cent), diabetes (14 per cent), and respiratory disease (8 per cent), accounting in total for 75 per cent of all deaths of persons with diabetes. These four main causes are the same in the population of other BC residents (see Table H1 in Appendix H).

Within these broad categories, Status Indians with diabetes account for a disproportionate number of deaths relative to their proportion of the population (4 per cent in 2003/2004). The population of Status Indians with diabetes accounted for 24 per cent of all circulatory system deaths, 17 per cent of all malignant neoplasm (cancer) deaths, 100 per cent of all deaths due to diabetes, and 17 per cent of respiratory system deaths within the entire Status Indian population. These percentages are similar to those of other BC residents with diabetes. These high proportions are reflected in the differences in the age-standardized rates for Status Indians with diabetes and Status Indians without diabetes. In all of these categories, the rate ratio (RR) for persons with diabetes is elevated: circulatory system (2.6 RR), malignant neoplasms (2.1 RR), and respiratory system (1.9 RR). These rate ratios are similar to the population of other BC residents. When rates for Status Indians with diabetes are compared to other BC residents with diabetes, risks for these main categories are similar with the exception of respiratory disease, where rates are 80 per cent higher in the Status Indian population.

Cardiovascular Disease Mortality

More specific causes of death show even greater disparities between Status Indians with and without diabetes. Acute myocardial infarction (heart attacks) and other ischaemic heart disease account for 18 per cent of all deaths for persons with diabetes. Death rates for these causes are 3 times higher among Status Indians with diabetes (3.3 RR and 3.0 RR), who also account for 29 per cent of all deaths due to these causes. The risk of death due to cerebrovascular disease (stroke) is double for persons with diabetes (2.1 RR). Eight per cent of all deaths for persons with diabetes are due to stroke. Persons with diabetes also account for a disproportionate 23 per cent of all deaths due to stroke. While the risk of death due to heart failure is 50 per cent higher among persons with diabetes—who account for 22 per cent of all heart failure deaths—the difference is not statistically significant. Similarly, other circulatory system causes show increased risk and a disproportionate number of deaths for persons with diabetes. The rate ratios and proportions of deaths are similar among other BC residents and Status Indians with diabetes.

Cancer Mortality

The malignant neoplasm (cancer) category accounts for a significant proportion of deaths and an elevated risk for persons with diabetes. While rates are higher for some

individual causes of cancer, the numbers of deaths are small and only cancer of the colon and rectum stands out as being statistically significantly different. When Status Indians with diabetes are compared to other BC residents with diabetes, mortality rates due to cancer are similar.

Respiratory Disease Mortality

In the respiratory system category, persons with diabetes experience higher risk of death for both pneumonia/influenza and chronic respiratory disease (1.6 RR and 1.4 RR), which account for 15 per cent and 19 per cent of all deaths due to these causes. When Status Indians with diabetes are compared to other BC residents with diabetes, pneumonia/influenza death rates are 70 per cent higher among Status Indians.

Mortality Due to Other Causes

Despite the smaller numbers of deaths, several other causes are notable for the increased risk of death experienced by Status Indians with diabetes. Chronic renal failure carries over two times the risk of death for persons with diabetes (2.6 RR), and persons with diabetes account for 25 per cent of all deaths due to chronic renal failure. Chronic renal failure death rates are 60 per cent higher among Status Indians with diabetes when compared with other BC residents with diabetes.

The risk of death due to chronic liver disease/cirrhosis is double (2.3 RR) for persons with diabetes, and accounts for 11 per cent of all deaths due to this cause. Relative to other BC residents with diabetes, mortality rates are 2.6 times higher among Status Indians with diabetes. Possibly associated with this category, the risk of death due to the use of alcohol is double (1.8 RR) for Status Indians with diabetes when compared to Status Indians without diabetes. When compared with other BC residents with diabetes, the rates are almost five times higher for this cause.

It is important to note external causes of morbidity and mortality. While rates are not significantly different among Status Indians with and without diabetes, rates are 2.6 times higher among Status Indians with diabetes when compared to other BC residents with diabetes (see Table H1 in Appendix H).

Infant Macrosomia Among First Nations in British Columbia – Prevalence, Trends and Characteristics

A recently completed study of high birth weights (macrosomia) among British Columbia First Nations unexpectedly found a lower overall prevalence of diabetic birth complications among First Nations compared to non-First Nations mothers. However, for those mothers who had a diabetic complication, a First Nations mother was more likely to have delivered a macrosomic baby than her non-First Nations counterpart. These findings reinforce the importance of supporting maternal health and effective prenatal care, particularly for First Nations mothers at risk of diabetic complications.

The study was based on birth records from the British Columbia Vital Statistics Agency, and is expected to be published in the near future (W.J. Kierans, personal communication, November 8, 2005).

Mobile Diabetes Telemedicine Clinic

There are often barriers to effective diabetes care in northern reserves, due to geographic isolation, and lack of access to services. Long-term complications of diabetes, such as diabetic retinopathy (which can result in vision loss if untreated), are preventable and/or treatable with good care. The Mobile Diabetes Telemedicine Clinic is a project started by the First Nations Chiefs' Health Committee, and subsequently transferred to Carrier Sekani Family Services. The project covers a large area of Northern British Columbia, and works to provide on-reserve diagnosed diabetics (and individuals with signs of glucose intolerance) with quality care for their condition.

With funding from the First Nations and Inuit Health Branch, Health Canada, this project has a team that provides screening for diabetic retinopathy in a series of clinics. Clients are screened, and are referred to specialists if abnormalities are found. The clinic is supported remotely by a retina specialist and endocrinologist, who receive photographic images and medical records in an electronic format. In addition to vision screening, the team also provides diabetic testing and education, including blood and urine tests, foot exams and foot care, and advice on managing this chronic condition. Clients can review their health with an assessment questionnaire, and go over a wellness plan with the Diabetes Nurse Educator.

The project has been in place for over three years, and has been well received by the communities it has visited.

Sources: Carrier Sekani Family Services. (n.d.). *CSFS Diabetes Outreach Program.* Retrieved November 9, 2005, from http://www.csfs.org/Pages/Services/Health/Diabetes/diabetes_main.html

Carrier Sekani Family Services. (2004, December). First Nations on-reserve mobile diabetes telemedicine care clinic report. Tuz Beyaduk, 4.

Table 3.1 Cause of Death Comparison for Persons With and Without Diabetes, by Diagnostic Chapter and Selected Causes, Status Indians, BC, 1992/1993-2003/2004

Cause of Death	Deaths With Diabetes	% Deaths With Diabetes	% of Cause Persons With Diabetes	Deaths Without Diabetes	% Deaths Without Diabetes	ASMR With Diabetes	ASMR Without Diabetes	Rate Ratio	Confidence Interval Rate Ratio	
									Lower	Upper
Certain infectious and parasitic diseases A00-B99	40	3.1	11.4	311	4.6	5.5	2.5	2.1	1.5	3.1
Malignant Neoplasms (cancer) C00-C97	215	16.6	16.6	1082	15.9	30.9	14.7	2.1	1.6	2.7
Malignant Neoplasms of trachea and lung C33-C34	32	2.5	11.9	237	3.5	3.6	3.4	1.0	0.7	1.5
Malignant Neoplasms of female breast C50.0-C50.9	12	0.9	10.4	103	1.5	1.7	1.1	1.5	0.8	2.9
Malignant Neoplasms of colon and rectum C18-C21	31	2.4	21.5	113	1.7	3.9	1.6	2.5	1.6	3.8
Cervical Cancer C53	4	0.3	14.8	23	0.3	0.6	0.2	3.1	1.0	9.7
Prostate Cancer C61	6	0.5	9.1	60	0.9	0.8	1.1	0.7	0.3	1.7
Other malignant neoplasms	130	10.0	19.2	546	8.0	N/A	N/A	N/A	—	—
Diabetes mellitus E10-E14	186	14.3	100.0	—	—	N/A	N/A	N/A	—	—
Mental and behavioural disorders F00-F99	27	2.1	9.3	264	3.9	4.1	2.7	1.5	1.0	2.3
Use of Alcohol F10	21	1.6	9.1	210	3.1	3.3	1.9	1.8	1.1	2.8
Other mental and behavioural disorders	6	0.5	10.0	54	0.8	N/A	N/A	N/A	—	—
Diseases of the nervous system G00-G99	14	1.1	9.5	134	2.0	2.1	1.7	1.2	0.7	2.2
Diseases of the circulatory system I00-I99	460	35.5	24.3	1436	21.1	56.7	22.2	2.6	2.3	2.9
Acute Myocardial Infarction I21-I22	125	9.6	29.0	306	4.5	15.7	4.7	3.3	2.7	4.2
Other Ischaemic heart diseases I20, I23-I25	105	8.1	28.2	267	3.9	13.3	4.4	3.0	2.4	3.9
Cerebrovascular diseases I60-I69	99	7.6	22.9	334	4.9	11.4	5.3	2.1	1.7	2.7
Hypertensive Disease I10-I13, I15	6	0.5	20.7	23	0.3	0.7	0.4	1.7	0.7	4.4
Heart Failure I50	37	2.9	21.9	132	1.9	3.8	2.5	1.5	1.0	2.2
Diseases of Arteries I70-I78	17	1.3	22.1	60	0.9	2.2	0.9	2.5	1.4	4.5
Other diseases of the circulatory system	71	5.5	18.4	314	4.6	N/A	N/A	N/A	—	—

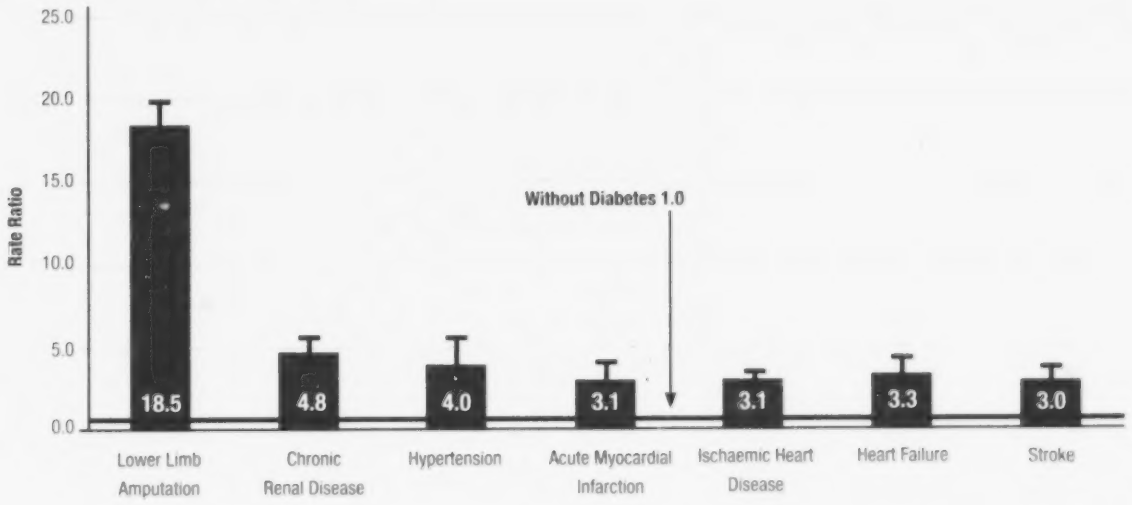
Table 3.1
(continued)

Cause of Death	Deaths With Diabetes	% Deaths With Diabetes	% of Cause Persons With Diabetes	Deaths Without Diabetes	% Deaths Without Diabetes	ASMR With Diabetes	ASMR Without Diabetes	Rate Ratio	Confidence Interval Rate Ratio	
									Lower	Upper
Diseases of the respiratory system J00-J99	104	8.0	16.5	525	7.7	16.0	8.3	1.9	1.3	3.0
Pneumonia/Influenza J10-J18.1, J18.8, J18.9	48	3.7	15.1	269	4.0	6.4	4.1	1.6	1.1	2.2
Chronic Pulmonary Disease J41-J44	30	2.3	19.0	128	1.9	3.3	2.3	1.4	0.9	2.1
Other diseases of the respiratory system	26	2.0	16.9	128	1.9	N/A	N/A	N/A	—	—
Diseases of the digestive system K00-K93	85	6.6	13.9	526	7.7	13.2	5.8	2.3	1.8	2.9
Chronic liver disease/cirrhosis K70, K73-K74, K76.0-K76.1	34	2.6	11.1	272	4.0	5.7	2.5	2.3	1.6	3.3
Other diseases of the digestive system	51	3.9	16.7	254	3.7	N/A	N/A	N/A	—	—
Diseases of the genitourinary system N00-N99	35	2.7	25.7	101	1.5	4.7	1.7	2.7	1.8	4.1
Chronic Renal Disease N18-N19	24	1.9	25.3	71	1.0	3.2	1.3	2.6	1.6	4.2
Other diseases of the genitourinary system	11	0.8	26.8	30	0.4	N/A	N/A	N/A	—	—
External causes of morbidity and mortality V01-Y98	82	6.3	4.1	1941	28.6	13.8	13.8	1.0	0.8	1.3
Accidental Poisoning X40-X49	22	1.7	4.7	450	6.6	4.3	3.0	1.4	0.9	2.2
Suicide X60-X84, Y87.0	11	0.8	2.7	392	5.8	2.2	2.5	0.9	0.5	1.6
Adverse Affects of Drugs Y40-Y59	0	0.0	0.0	4	0.1	0.0	0.0	—	—	—
Med/Surg misadventure, etc. Y60-Y84	1	0.1	10.0	9	0.1	0.1	0.1	1.0	0.1	8.0
Falls W00-W19	11	0.8	7.7	131	1.9	1.1	1.5	0.7	0.4	1.4
Other external causes of morbidity and mortality	37	2.9	3.7	955	14.1	N/A	N/A	N/A	—	—
Other Causes	49	3.8	9.3	477	7.0	N/A	N/A	N/A	—	—
All Causes	1297	100.0	16.0	6797	100.0	180.4	77.7	2.3	2.1	2.5

*Note: Figure 3.9a and Table 3.1 present rate ratios based on different data over different time periods and using different age groupings for the underlying age-standardized mortality rates. As such, the rate ratios may not be directly comparable. Figure 3.9a is using probabilistic linkage to overall death counts, age-standardized mortality rates, and rate ratios over a 5-year period (age-standardized using 14 age groups). Table 3.1 is using deterministic linkage to cause of death counts, age-standardized mortality rates, and rate ratios over a 12-year period (age-standardized using three age groups). Age-standardized mortality rate (ASMR) per 10,000 and rate ratio with 95 per cent confidence interval (CI).

Conditions Associated With Diabetes

Figure 3.12a Age-Standardized Hospitalization Rate Ratios for Selected Associated Conditions, Status Indians With and Without Diabetes, BC, 1998/1999-2002/2003



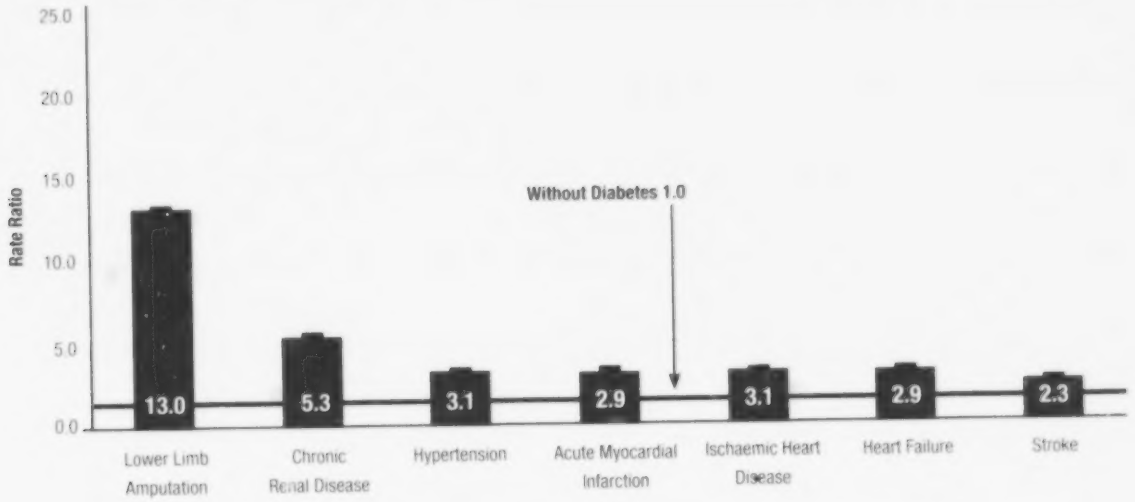
Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

"Over the time period 1998/1999 to 2002/2003, Status Indians with diabetes have about 20 times the risk of amputations and 3 to 5 times the risk of other co-morbidities compared to those without diabetes."

Status Indians with diabetes show an increased risk of hospitalizations for selected conditions often associated with diabetes (Figure 3.12a). Over the time period 1998/1999 to 2002/2003 Status Indians with diabetes have about 20 times the risk of amputations and 3 to 5 times the risk of hospitalizations for the other selected co-morbid conditions (co-existing medical conditions) presented when compared to those without diabetes. Generally, persons with diabetes experience much higher rates of hospitalization for other conditions associated with diabetes.

Figure 3.12b

Age-Standardized Hospitalization Rate Ratios for Selected Associated Conditions, Other BC Residents With and Without Diabetes, BC, 1998/1999-2002/2003



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005.

Figure 3.12b shows the hospitalization co-morbidity rate ratios for other BC residents. Status Indians with diabetes experience additional risk for these conditions as compared to other BC residents with diabetes.

Conditions and Costs Associated with Diabetes

Table 3.1a

Prevalence of Selected Co-morbid Hospitalized Conditions Associated with Diabetes, Status Indians, BC, 2003/2004*

Selected Hospitalized Conditions	Persons with Diabetes			Persons with vs Persons without Diabetes Rate Ratio	Persons without Diabetes	
	Persons with Conditions	Per cent of Diabetics with Condition	Per cent of those with Condition have Diabetes	Age-adjusted Prevalence Rate Ratio	Number with Condition	Per cent of Non-Diabetics with Condition
No co-morbid condition	3,785	67.1	2.7	—	135,979	96.5
Cardiovascular Diseases (CVD)	1,818	32.2	27.6	3.3	4,775	3.4
Ischaemic Heart Diseases (IHD)	835	14.8	38.7	3.5	1,321	0.9
Acute Myocardial infarction	303	5.4	38.3	3.9	488	0.3
Other IHD	532	9.4	39.0	3.6	833	0.6
Hypertension	1,146	20.3	39.7	5.4	1,742	1.2
Heart Failure	469	8.3	40.5	3.7	689	0.5
Stroke	389	6.9	31.0	2.7	864	0.6
Other CVD	152	2.7	10.0	1.8	1,375	1.0
Chronic Renal Disease	219	3.9	39.0	5.5	342	0.2
Lower Limb Amputation	47	0.8	73.4	31.5	17	0.01
Any co-morbid condition	1,855	32.9	27.4	3.1	4,907	3.5
All persons	5,640	—	3.8	—	140,886	—

*Persons living in 2003/2004 who have been hospitalized at any time during the period 1992/1993 – 2003/2004 for the listed conditions. Persons may be counted in more than one category since they may have more than one condition (15 per cent of persons with diabetes have more than one condition).

Tables 3.1a, 3.1b, 3.2a, and 3.2b show the relative proportions and costs of various conditions for persons with and without diabetes among Status Indians and other BC residents.[3] In both populations, about one-third of persons with diabetes had one or more of these conditions. Age-standardization to adjust for the older age structure of the diabetes population results in rate ratios that are about 3 times higher for Status Indians with diabetes and about 2.5 times higher for other BC residents. Generally, Status Indians with diabetes experience higher rates of these selected hospitalized conditions.

[3] *For each of Tables 3.1b and 3.2b, comparisons of costs can be made between the population with diabetes and the population without diabetes for each of the hospitalized condition categories. Comparisons of costs for Status Indians and other BC residents should not be made as they have not been standardized to a common population.*

Table 3.1b

Cost of Various Conditions Associated with Diabetes, Status Indians, BC, 2003/2004*

Selected Hospitalized Conditions	Persons with Diabetes			Persons without Diabetes			Age-adjusted Cost Rate Ratio (Per Person)
	Cost	Per cent of Costs for Those with Diabetes	Cost Per Person**	Cost	Per cent of Costs for Those without Diabetes	Cost Per Person**	
No co-morbid condition	$8,536,000	6.5	$2,851	$123,467,000	93.5	$908	3.1
Cardiovascular Diseases (CVD)	$18,047,000	37.1	$8,844	$30,603,000	62.9	$6,409	1.4
Ischaemic Heart Diseases (IHD)	$9,311,000	50.9	$10,640	$8,991,000	49.1	$6,806	1.6
Acute Myocardial Infarction	$3,813,000	50.5	$11,147	$3,742,000	49.5	$7,668	1.5
Other IHD	$5,497,000	51.2	$10,102	$5,249,000	48.8	$6,301	1.6
Hypertension	$12,122,000	49.9	$9,789	$12,156,000	50.1	$6,978	1.4
Heart Failure	$8,339,000	55.0	$20,421	$6,813,000	45.0	$9,888	2.1
Stroke	$4,814,000	42.0	$10,764	$6,657,000	58.0	$7,704	1.4
Other CVD	$1,074,000	12.6	$5,313	$7,436,000	87.4	$5,408	1.0
Chronic Renal Disease	$5,883,000	56.2	$22,774	$4,590,000	43.8	$13,421	1.7
Lower Limb Amputation	$1,781,000	95.8	$33,027	$78,000	4.2	$4,562	7.2
Any co-morbid condition	$18,955,000	37.4	$9,238	$31,702,000	62.6	$6,461	1.4
All persons	$27,492,000	15.1	$3,652	$155,169,000	84.9	$1,101	3.3

*Cost estimates are derived by attributing all costs (Hospital, Medical Services Plan, PharmaCare) in a given year to two groups—either persons with diabetes or persons without diabetes. Because persons may have more than one condition, the sum of costs does not equal the total.

**Costs for persons with diabetes are adjusted to reflect the age structure of the population without diabetes for each selected hospitalized condition category. These estimates relate to the costs recorded for these services, and are not intended to reflect payment responsibility by any level of government.

Table 3.2a

Prevalence of Selected Co-morbid Hospitalized Conditions Associated with Diabetes, Other BC Residents, BC, 2003/2004*

Selected Hospitalized Conditions	Persons with Diabetes: Persons with Conditions	Persons with Diabetes: Per cent of Diabetics with Condition	Persons with Diabetes: Per cent of those with Condition who have Diabetes	Persons with vs Persons without Diabetes Rate Ratio: Age-adjusted Prevalence Rate Ratio	Persons without Diabetes: Number with Condition	Persons without Diabetes: Per cent of Non-Diabetics with Condition
No co-morbid condition	146,687	69.6	3.8	—	3,687,647	94.9
Cardiovascular Diseases (CVD)	63,616	30.2	24.4	2.4	196,927	5.1
Ischaemic Heart Diseases (IHD)	31,534	15.0	28.8	2.6	77,866	2.0
Acute Myocardial Infarction	12,978	6.2	29.3	2.8	31,345	0.8
Other IHD	18,556	8.8	28.5	2.5	46,521	1.2
Hypertension	39,418	18.7	31.0	3.2	87,705	2.3
Heart Failure	13,715	6.5	33.7	3.1	27,013	0.7
Stroke	12,107	5.7	26.7	2.2	33,153	0.9
Other CVD	5,714	2.7	12.4	1.5	40,359	1.0
Chronic Renal Disease	5,431	2.6	41.2	6.2	7,744	0.2
Lower Limb Amputation	1,242	0.6	59.1	11.7	860	0.02
Any co-morbid condition	64,161	30.4	24.4	2.4	198,654	5.1
All persons	210,848	—	5.1	—	3,886,301	—

*Persons living in 2003/2004 who have been hospitalized at any time during the period 1992/1993 – 2003/2004 for the listed conditions. Persons may be counted in more than one category since they may have more than one condition (15 per cent of persons with diabetes have more than one condition).

As seen in Tables 3.1b and 3.2b, age-standardized costs per person are about 3 times higher for persons with diabetes in both the Status Indian and other BC resident populations. For persons with diabetes and any of the other selected conditions, costs are about 50 per cent higher in both the Status Indian and other BC resident populations. Persons with diabetes in both populations account for a large proportion of costs for all persons with the selected conditions.

Table 3.2b

Cost of Various Conditions Associated With Diabetes, Other BC Residents, BC, 2003/2004*

Selected Hospitalized Conditions	Persons with Diabetes			Persons without Diabetes			Age-adjusted Cost Rate Ratio (Per Person)
	Cost	Per cent of costs for Those with Diabetes	Cost Per Person**	Cost	Per cent of Costs for Those without Diabetes	Cost Per Person**	
No co-morbid condition	$356,870,000	10.1	$2,398.00	$3,156,215,000	89.9	$856.00	2.8
Cardiovascular Diseases (CVD)	$648,862,000	32.3	$10,479.00	$1,362,222,000	67.7	$6,917.00	1.5
Ischaemic Heart Diseases (IHD)	$356,921,000	37.6	$11,290.00	$591,400,000	62.4	$7,595.00	1.5
Acute Myocardial Infarction	$168,844,000	39.1	$12,840.00	$263,272,000	60.9	$8,399.00	1.5
Other IHD	$188,078,000	36.4	$10,146.00	$328,128,000	63.6	$7,053.00	1.4
Hypertension	$423,819,000	39.2	$10,898.00	$656,150,000	60.8	$7,481.00	1.5
Heart Failure	$237,912,000	41.8	$17,896.00	$331,108,000	58.2	$12,257.00	1.5
Stroke	$152,796,000	34.1	$12,787.00	$294,641,000	65.9	$8,887.00	1.4
Other CVD	$44,972,000	17.5	$7,887.00	$211,929,000	82.5	$5,251.00	1.5
Chronic Renal Disease	$138,738,000	51.8	$24,732.00	$129,048,000	48.2	$16,664.00	1.5
Lower Limb Amputation	$31,716,000	72.3	$23,594.00	$12,170,000	27.7	$14,152.00	1.7
Any co-morbid condition	$657,604,000	32.3	$10,524.00	$1,381,310,000	67.7	$6,953.00	1.5
All persons	$1,013,473,000	18.3	$3,451.00	$4,537,525,000	81.7	$1,168.00	3.0

*Cost estimates are derived by attributing all costs (Hospital, Medical Services Plan, PharmaCare) in a given year to two groups—either persons with diabetes or persons without diabetes. Because persons may have more than one condition, the sum of costs does not equal the total.

**Costs for persons with diabetes are adjusted to reflect the age structure of the population without diabetes for each selected hospitalized condition category.

Table 3.3a **Percentage of Status Indians With and Without Diabetes, by Number of Diabetes-Associated Conditions, BC, 2003/2004**

Number of Diabetes-Associated Conditions	Per cent Persons with Diabetes	Per cent Persons without Diabetes	Age-Adjusted Rate Ratio
0	67.11	96.52	—
1	16.95	2.70	2.85
2	9.79	0.59	4.71
3	3.88	0.16	4.65
4	1.81	0.03	9.14
5	0.43	0.002	33.21
6	0.04	—	—

Table 3.3b **Percentage of Other BC Residents With and Without Diabetes, by Number of Diabetes-Associated Conditions, BC, 2003/2004**

Number of Diabetes Associated Conditions	Per cent Persons with Diabetes	Per cent Persons without Diabetes	Age-Adjusted Rate Ratio
0	69.60	94.89	—
1	16.21	3.63	2.08
2	8.98	1.09	3.00
3	3.67	0.31	3.82
4	1.28	0.07	5.60
5	0.27	0.009	9.62
6	0.02	<0.001	28.47

Persons with diabetes in both the Status Indian and other BC resident populations are burdened with a greater number of conditions often associated with diabetes (Tables 3.3a and 3.3b).

In Summary

- The prevalence of diabetes among the First Nations population in Canada has increased significantly in the last 50 years (Health Canada, 2000).
- The combination of the western diet high in carbohydrates, simple sugars, and fats, and a sedentary, inactive lifestyle has more than likely contributed to the epidemic of diabetes among the First Nations population.
- At the end of the fiscal year 2003/2004, there were an estimated 5,600 Status Indians living with diabetes in British Columbia.
- The prevalence of diabetes in the Status Indian population is higher among females in almost all age groups. This is the reverse of the pattern in the other BC resident population.
- The prevalence rate of diabetes among Status Indians is about 1.4 times higher than other BC residents.
- The age-standardized prevalence rate of diabetes for Status Indians is higher than other BC residents in all Health Authorities.
- From 1998/1999 to 2002/2003, around 2,600 new cases of diabetes were identified among Status Indians —approximately 520 new cases each year.
- Vancouver Coastal Health Authority had the highest age-standardized incidence rate of diabetes at 0.63 per 100 population, while Northern Health Authority had the lowest at 0.46 per 100 population.
- The Status Indian population with diabetes have mortality rate ratios that are about two times higher than those without diabetes.
- On average, each year, more than 100 Status Indians with diabetes die in British Columbia.
- Status Indians with diabetes accounted for 24 per cent of all circulatory system deaths, 17 per cent of all malignant neoplasm (cancer) deaths, and 17 per cent of all respiratory system deaths among the Status Indian population.
- Status Indians with diabetes have about 20 times the risk of amputations and 3 to 5 times the risk of other hospitalized co-morbidities compared to those without diabetes.
- Generally, Status Indians with diabetes experience higher rates of selected co-morbid hospitalized conditions such as lower limb amputations, chronic renal disease, hypertension, acute myocardial infarction (heart attack), ischaemic heart disease, heart failure and stroke.
- Costs for Status Indians with diabetes are three times higher than for Status Indians without diabetes.
- When age-standardized to the overall population, the average cost per person with diabetes was $4,161 for Status Indians compared to $3,508 for other BC residents. The higher health care costs for the Status Indians reflect their higher hospitalized co-morbidities and higher mortality.

Chapter 4 Prevention of Diabetes

Diabetes is among the most prevalent of all chronic diseases worldwide. As mentioned in Chapter 2 of this report, the prevalence of diabetes is increasing in British Columbia. Over 90 per cent of diabetes cases diagnosed are Type 2 diabetes, and it is estimated that 4 out of 10 people with diabetes will develop complications such as blindness, kidney disease, cardiovascular disease, amputations, and reduced life expectancy (McParland, 2002). However, research indicates that Type 2 diabetes is preventable. The methods of preventing Type 2 diabetes are generally categorized into primary, secondary, and tertiary prevention (Last, 1980). Tertiary prevention is considered to be management of diabetes and will be covered in Chapter 5 of this report.

Primary Prevention

Primary prevention comprises actions that prevent the development of diabetes in the first place (Last, 1980). These actions are based on an understanding of the causes for the rising trends of Type 2 diabetes and of effective strategies to address them. Primary prevention programs promote healthy lifestyles through good nutritional choices, physical activity, as well as social and behavioural practices (e.g., no smoking) that would reduce the burden of chronic diseases such as diabetes.

In general, social, economic, and cultural conditions contribute to the overall health of a population and the distribution of the burden of disease. These factors shape the behaviour of individuals in societies and also affect the access of individuals to resources that are needed for good health. As a result, the social inequalities that are created are major determinants of health, with key conditions such as inequalities in early childhood development, educational attainment, social-emotional competence, unemployment, social status, social hierarchy, and relative deprivation and poverty (MOHP, Population Health and Wellness, November 2003).

The various societal conditions that have an impact on the development of chronic disease appear in two ways: social programming and biological programming. Social programming describes the differential access to resources that affect the determinants of health while biological programming describes the effect of societal conditions on the psyche and the body directly altering biochemistry, physiology, and cellular and organ functioning. In both cases, these changes interact with the genetic and biological patterns of individuals over the course of their lives, affecting their psychological and physiological patterns and creating challenges to their health. The complexity of these conditions and their effects therefore imply that "there is seldom if ever a simple 'single cause, single effect' relationship in chronic disease" (MOHP, Population Health and Wellness, November 2003).

Our behaviour and lifestyle are the result of our psychological makeup, modified by the knowledge, attitude, values, and behaviour that we learn and the way we are influenced by family dynamics, social pressures, and community and societal and cultural influences. Our resulting lifestyle then is not freely chosen but is rather

a reflection of the norms in which we are immersed. Evidence shows that around 25 to 30 per cent of the burden of disease in Canada can be attributed to risk factors such as smoking, physical inactivity, unhealthy eating habits, and social, economic, and cultural conditions. Many of these risk factors directly underlie the increasing trend in diabetes prevalence.

Impact of Obesity and Physical Inactivity on Diabetes in British Columbia

Many studies have shown that the two major factors that contribute to the incidence and prevalence of Type 2 diabetes are obesity and physical inactivity. Almost 80 per cent of those diagnosed with Type 2 diabetes are found to be overweight (McParland, 2002). The rate of obesity is usually determined by calculation of the Body Mass Index (BMI). Although imperfect, the BMI provides an indication of whether an individual is overweight or obese. BMI is calculated by dividing weight in kilograms by height in metres squared. The resulting number is somewhere between 15 and 40 (see table below). Individuals with a BMI of 25-29.9 are considered overweight and those with a BMI of 30 and above are considered obese.

Body Mass Index

Underweight	<18.5
Normal	18.5-24.9
Overweight	25-29.9
Obese	>30

There is a constellation of conditions that together are known as "metabolic syndrome". Whether this is a disease state or only a collection of factors associated with increased risk for a number of diseases such as diabetes is a matter of debate.

People with metabolic syndrome are at an increased risk of developing coronary heart disease, stroke, peripheral vascular disease, and Type 2 diabetes. Although some genetic factors may play a role in the development of metabolic syndrome, environmental factors such as physical inactivity and obesity contribute significantly to the development of this syndrome (Canadian Diabetes Association, 2003).

Metabolic Syndrome

Metabolic syndrome is characterized by a group of conditions that include abnormalities of lipid and glucose metabolism as well as abdominal obesity. Major criteria for metabolic syndrome include:

Increased waist circumference

Men: > 102 cm (40 in)
Women: > 88 cm (35 in)

Fasting plasma glucose ≥ 6.1 mmol/L

Elevated blood pressure

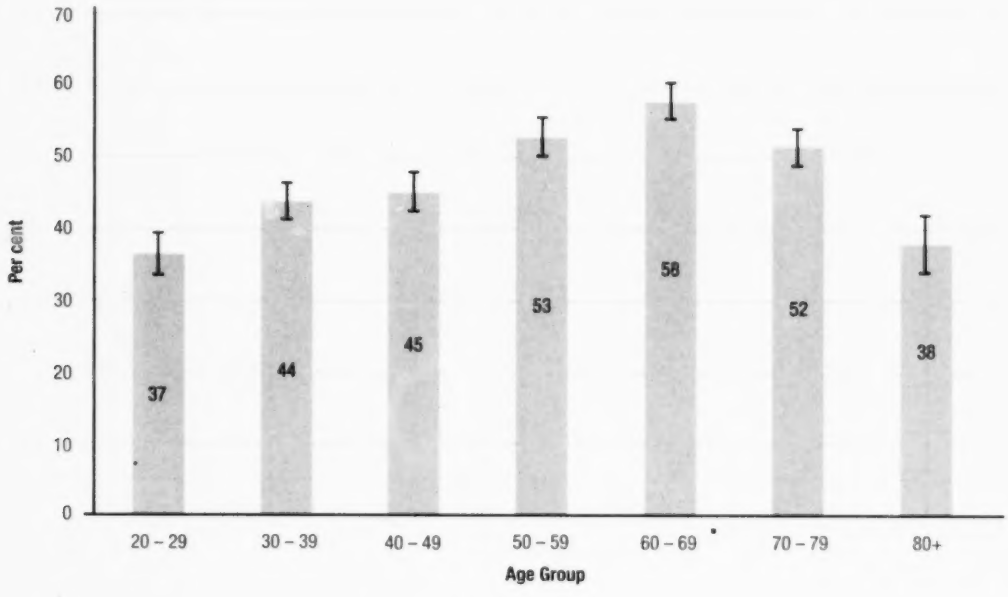
Systolic ≥ 130 mm Hg
Diastolic ≥ 85 mm Hg

Serum triglyceride level ≥ 1.7 mmol/L
Decreased high-density lipoprotein (HDL) cholesterol level

Men < 1.0 mmol/L
Women < 1.3 mmol/L

(Canadian Diabetes Association, 2003)

Figure 4.1 Overweight and Obese Individuals by Age Group, BC, 2003 (BMI 25+)



Sample size for BC: 14,998

Source: Canadian Community Heath Survey (Stats Canada) File, 2003 (cycle 2.1)

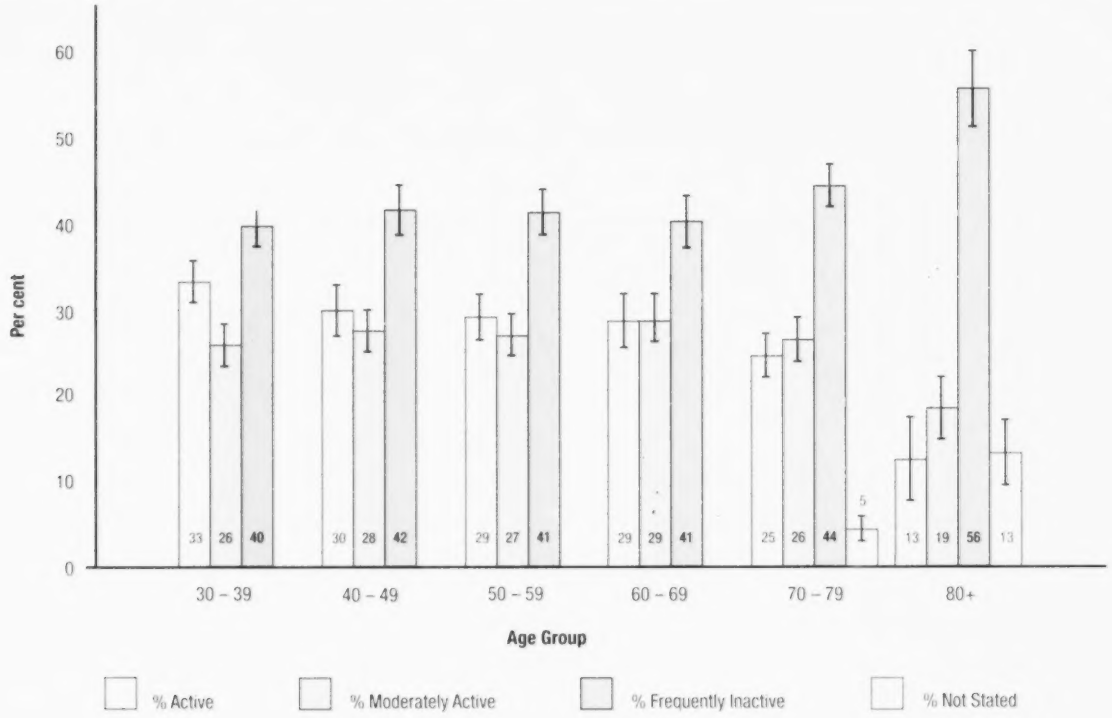
"In 2003, 46 per cent of individuals in British Columbia, 20 years of age and older, identified themselves as being overweight or obese."

In 2003, the Canadian Community Health Survey (CCHS) of Statistics Canada indicated that over 50 per cent of individuals between the ages of 50 and 79 self-reported that they were overweight or obese in British Columbia. All these individuals had a BMI of 25 or greater.

The highest percentage of overweight and obesity was among those who were between 60-69, and the lowest was among those 20-29.

Overall, in 2003, 46 per cent of individuals 20 years of age and older in British Columbia, identified themselves as being overweight or obese. It is important to note that self-reported data on obesity can be lower than actual rates; therefore it is possible that actual obesity rates are much higher than indicated.

Figure 4.2 Physical Activity by Age Group, BC, 2003



Sample size for BC: 14,998

Note: The sample size for age groups under 30 years of age was based on a small number of people and results for this age group were therefore excluded.

Respondents are classified as active, moderately active or inactive based on an index of average daily physical activity over the past three months. For each leisure time physical activity engaged in by the respondent, an average daily energy expenditure is calculated by multiplying the number of times the activity was performed by the average duration of the activity by the energy cost (kilocalories per kilogram of body weight per hour) of the activity. The index is calculated as the sum of the average daily energy expenditures of all activities. Respondents are classified as follows: 3.0 kcal/kg/day or more = physically active; 1.5 to 2.9 kcal/kg/day = moderately active; less than 1.5 kcal/kg/day = inactive.

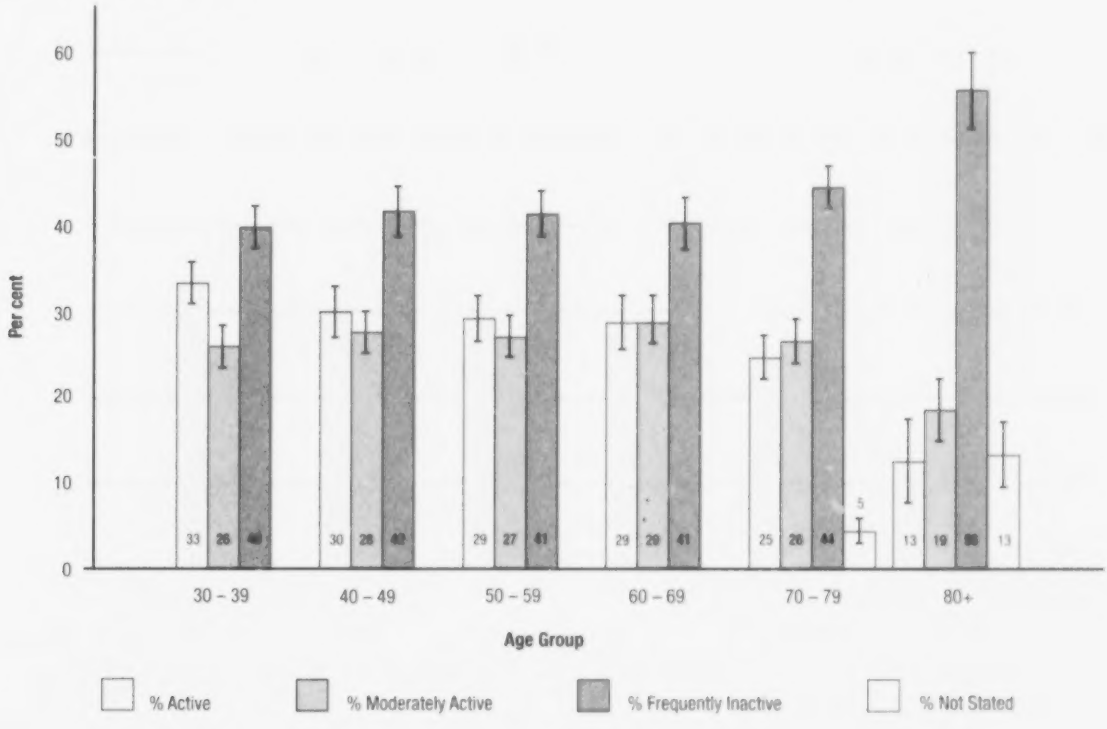
Source: Canadian Community Heath Survey (Stats Canada) File, 2003 (cycle 2.1)

"In 2003, the overall rate of physical inactivity was 41 per cent in British Columbia."

In 2003, the CCHS data showed that in British Columbia, 41 per cent of individuals 30 years of age and over indicated that they were inactive in their leisure time.

The highest percentage of inactivity was reported by those 80+ at 50 per cent.

Figure 4.2 Physical Activity by Age Group, BC, 2003



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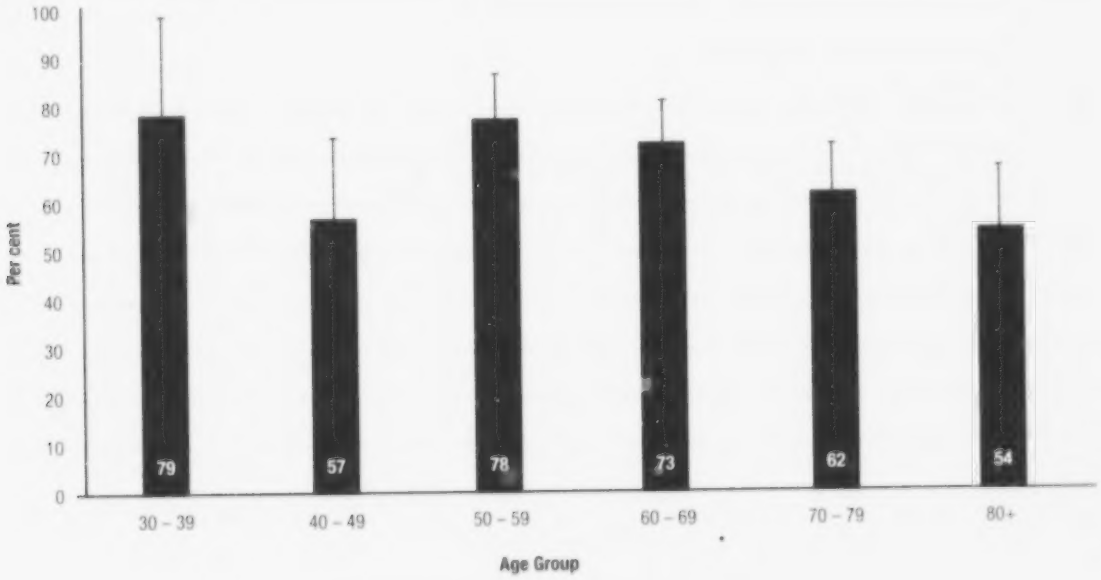
The highest percentage of inactivity was reported by those 80+ at 50 per cent.

Figure 4.3 Persons With Diabetes Who Were Overweight or Obese by Age Group, 2003, (BMI 25+)



Sample size for BC: 14,998.

Note: The sample size for age groups under 30 years of age were based on a small number of people and results for this age group were therefore excluded.

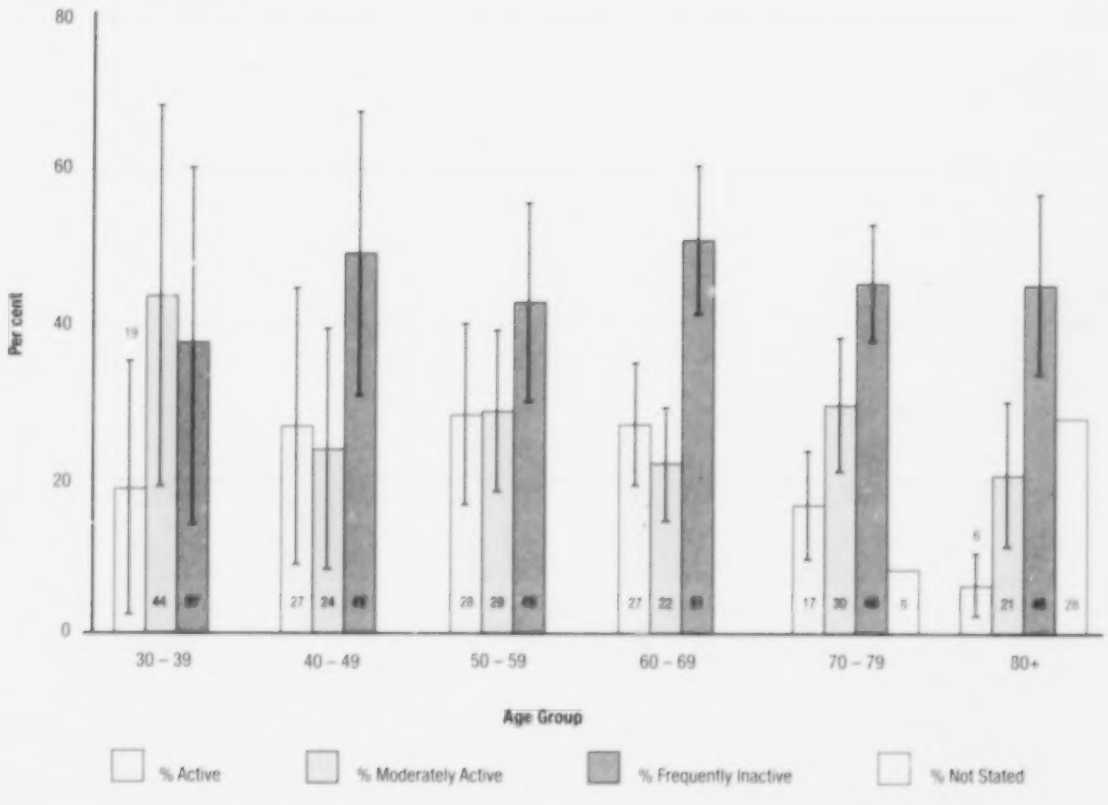
Source: Canadian Community Heath Survey (Stats Canada) File, 2003 (cycle 2.1)

"In 2003, around 69 per cent of individuals who had diabetes identified themselves as being overweight or obese."

In 2003, based on the CCHS, around 69 per cent of individuals who had diabetes identified themselves as also being overweight or obese.

The highest percentage of those who had diabetes and were also overweight or obese, were those between 30-39 and 50-59 at 79 and 78 per cent respectively. Persons with diabetes had a higher prevalence of overweight and obesity than the BC average for ages 30-39, 50-59, and 60-69.

Figure 4.4 Persons With Diabetes and Physical Activity, BC, 2003



Sample size for BC: 14,998.

Note: Sample sizes for age groups under 30 years of age were based on small number of people and were therefore excluded. Data for those under 50 years of age should also be interpreted with caution as the sample sizes were smaller than other age groups and were therefore presented with much wider confidence intervals.

Source: Canadian Community Heath Survey (Stats Canada) File, 2003 (cycle 2.1)

"In 2003, over 48 per cent of those who had diabetes indicated that they were physically inactive."

In 2003, the CCHS data showed that in British Columbia, over 48 per cent of those who had diabetes also indicated that they were physically inactive.

The highest percentage of those who had diabetes and were also physically inactive was between ages of 60-69.

Forum on Childhood Obesity March 2005 Vancouver, British Columbia

On March 3-4, 2005, a selected group of leaders from a variety of sectors gathered in Vancouver to review the extent and the implications of childhood obesity and to examine the evidence for effective prevention. The objectives of the forum were to extend the partnerships and integration of initiatives, to promote and foster research in prevention and management of obesity, and to address the issue of obesity in British Columbia in the context of chronic disease prevention and healthy living. The six recommendations suggested for the provincial action were:

Social marketing

An orchestrated, sustained, and consistent information campaign needs to take place to promote effective and proven steps to reduce obesity. These will include minimizing soft drink intake, limiting screen time to less than two hours per day, and breastfeeding for the first six months of life. Eating at least five daily servings of fruits and vegetables and increasing physical activity are also recommended.

Promoting healthier neighbourhoods and communities

New legislation and amendments are needed to make health impact assessments mandatory for all new developments. Bike lanes and walking paths, sidewalks, easier access to healthy foods with reasonable prices, and better public transportation are some of the changes that can be made to make neighbourhoods and communities healthier.

Support and enhance comprehensive school programs

A commitment from all political parties is needed to continue BC's acclaimed ActionSchools! BC program regardless of election outcome. This program promotes increased physical activity, nutritious eating, and other healthy policies. The program has shown promising interim results and should be continued and expanded by the provincial government.

Inventory of services

Health authorities must ensure that each region provides an inventory of all the programs and services that can help families adopt healthier eating habits and participate in physical activity.

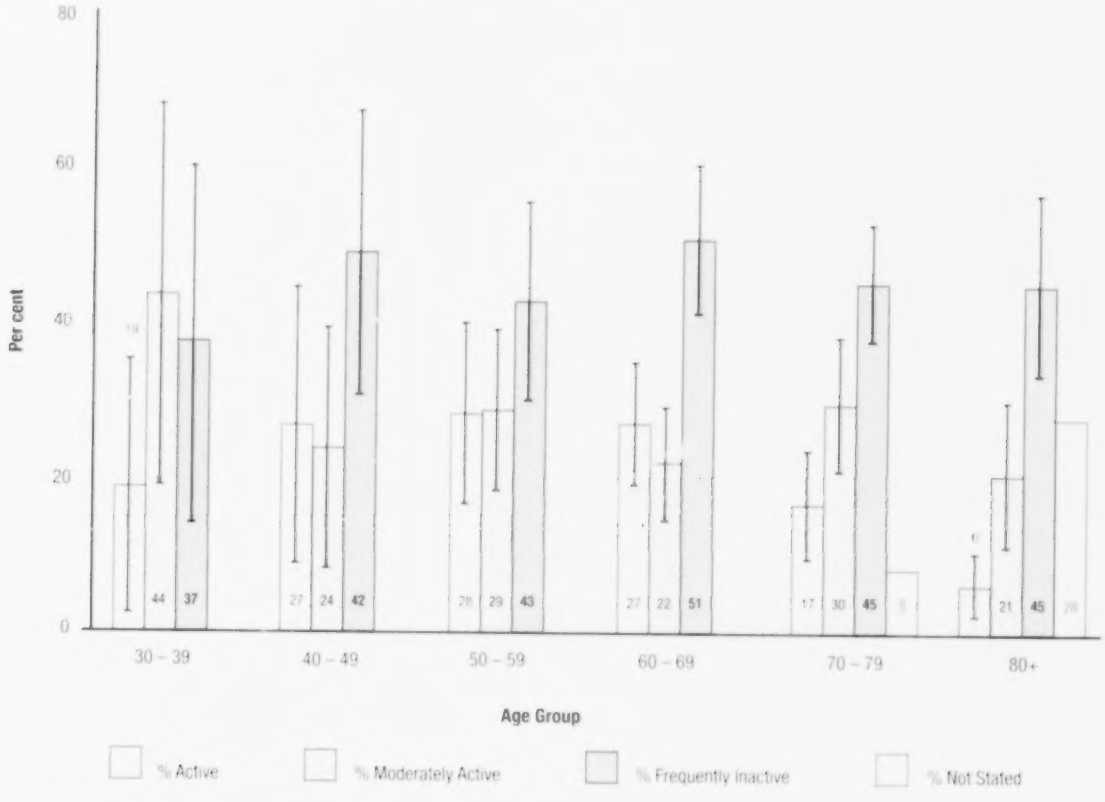
Make healthy weights and regular physical activity part of early childhood development goals

Regulations should be in place to ensure that all daycares and preschools adhere to guidelines for healthy eating and regular physical activity. The early years of a child (before age six) are crucial not only for cognitive, behavioural and physical functioning but also for diet and physical activity standards that need to be established and supported.

Create obesity assessment and treatment centres

Health authorities need to have assessment and treatment centres that are based on best practice models to help obese children and their families to access effective treatment and counselling programs.

Figure 4.4 Persons With Diabetes and Physical Activity, BC, 2003



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Approaches to Primary Prevention of Type 2 Diabetes

In general, there are two approaches to primary prevention of Type 2 diabetes: the high-risk approach and the population-based approach. The high-risk approach focuses on individuals at high risk of developing diabetes, while the population-based approach focuses on the whole population.

High-Risk Approach

The high-risk approach to diabetes concentrates on those who are most at risk of developing diabetes. These individuals are generally at the Impaired Glucose Tolerance (IGT) stage and have other risk factors such as obesity, physical inactivity, smoking, high blood pressure, socio-economic factors, family history, and genetic factors. The high-risk approach focuses on dietary changes, weight reduction, and increased physical activity. Many studies have proven that a combination of dietary changes and increased physical activity will delay the development of diabetes, or in some cases prevent the development of diabetes. The experiments and results of some of these landmark studies are summarized in the next section.

Landmark Studies with a Focus on High-Risk Prevention of Type 2 Diabetes

Finnish Study

In a Finnish study, 522 obese individuals (with an average age of 55 years) who had Impaired Glucose Tolerance (IGT) were chosen randomly to receive either a brief group counselling session on diet and exercise or intensive individualized instruction and guidance on weight reduction, food intake, and increasing physical activity. After about three years, there was a 58 per cent reduction in the incidence of diabetes in the group who received the intensive individual instruction, compared to those who received the brief counselling session. The group that received the individualized instruction was able to lose weight, reduce saturated fat intake, and increase fibre intake and exercise (Tuomilehto, Knowler, & Zimmet, 1992).

Da Qing IGT and Diabetes Study

A study was conducted in the city of Da Qing, China, to determine whether diet and exercise interventions in those with IGT might delay the development of Type 2 diabetes and thereby reduce the incidence of diabetic complications, such as cardiovascular, renal, and retinal disease.

The study included 577 individuals classified as having IGT. Subjects in the clinical trial were placed in either a control group, or in one of three treatment groups: diet only, exercise only, or diet plus exercise. Follow-up evaluations were conducted at 2-year intervals over a 6-year period to identify those individuals who had developed Type 2 diabetes. The study concluded that diet and/or exercise interventions led to a significant decrease in the incidence of diabetes over the 6-year period among those with IGT (Pan et al., 1997)

Impaired Glucose Tolerance (IGT)

Impaired Glucose Tolerance (IGT) is characterized by insulin resistance and the impairment of insulin secretion. It is believed that most people pass through an IGT period before they are diagnosed with Type 2 diabetes. These individuals are not yet diagnosed as having diabetes; however, their reaction to sugar is abnormal and around 10 per cent of them are likely to develop diabetes. The most evidence of success for primary prevention comes from targeting those with IGT. It has been proven that a combination of diabetes drugs and lifestyle changes—particularly changes related to losing weight and increasing physical activity— can help people delay or prevent the onset of diabetes; however, lifestyle changes related to losing weight and increasing physical activity have been the most effective. (McParland, 2002).

Swedish Study

During a 5-year screening program, 6,956 men aged 47-49 were screened, and 41 males in the early stages of Type 2 diabetes and 181 with IGT were selected for a study on long-term intervention with emphasis on diet and physical exercise. The 5-year program, consisting of dietary changes and increased physical activity with annual checkups, was completed by 90 per cent of the patients. In general, the body weight of the participants was reduced by 2.3 to 3.7 per cent. Glucose tolerance was normalized in more than 50 per cent of the patients with IGT and more than 50 per cent of the patients were in remission after the sixth year. The improvement in the glucose tolerance was directly related to the weight reduction and increased physical activity. The study concluded that long-term intervention consisting of diet and physical activity results in substantial metabolic improvements and may contribute to preventing or postponing the onset of Type 2 diabetes (Eriksson & Lindgarde, 1991).

Other Significant High-Risk Studies

In a recent study, 3,234 IGT patients were randomly assigned to placebo[1], metformin,[2] or a diet and exercise program that included a goal of 7 per cent weight loss and 150 minutes of physical activity per week. After 2.8 years, the incidence rates of diabetes was 11 per cent among those on placebo, 7.8 per cent among those on metformin, and 4.8 per cent among those in the diet and exercise program. The study concluded that the lifestyle change of diet and exercise is the most effective way to reduce the incidence of Type 2 diabetes among these patients (Diabetes Prevention Program Research Group, 2002).

Other studies have examined the effects of physical inactivity on the development of diabetes complications. In 1998, the *Clinical Practice Guidelines for the Management of Diabetes in Canada* concluded that physical activity improves insulin sensitivity and glycemic control, as well as inducing favourable changes in blood lipids, thus reducing the chances of complications (Meltzer et al., 1998).

Another recent study proved that lifestyle modification programs could be effective in helping obese people with Type 2 diabetes to reduce their weight and improve their blood glucose level. This study concluded that the most effective treatment for Type 2 diabetes is a combination of dietary intervention, physical activity, and the use of pharmacological agents (Marquis, Butler, Joseph, & Ney, 2000).

In 1997, Vlahos showed that hypertension and cigarette smoking increase the risk of macrovascular disease for people with diabetes. This study found that smoking increases the risk of coronary diseases by a factor of 2.5 to 3.5. Other diabetic complications such as nephropathy (kidney disease), retinopathy (eye disease), and neuropathy (nerve damage) are also adversely affected by smoking. Therefore, smoking cessation programs and treatment for hypertension are strongly recommended for people with diabetes (Marquis et al., 2000).

Population-Based Approach

The population-based approach focuses on prevention strategies for the whole population. Population-based interventions introduce strategies that change the environment people work and live in to make the healthy choice the easy choice. The most important element of a population-based approach is the integration of communities, workplaces, schools, and social and health care settings to provide a supportive environment and access to healthier choices, which will in turn reduce the burden of chronic diseases such as diabetes. Research has shown that effective population-based interventions are generally multi-faceted, allow participants some control, and are planned and resourced over a long period (International Union for Health Promotion and Education, 2000).

Population promotion and disease prevention strategies that have proven to be successful have the following combined elements:

- **Market regulation** – Regulation and restriction through fiscal policy.

[1] *Placebo (Latin for "I shall please") is a sugar or starch pill containing no medication, and is administered to patients for the purpose of medical studies.*
[2] *Medication used for regulating blood sugar level.*

- **Interventions by primary health care providers** – Support and care of a professional health care team with a multi-faceted and dynamic approach that is efficient and cost-effective.
- **Education and public information intervention** – Effective education and public information that contributes to a change in individual behaviour.
- **Socio-environmental interventions** – Public policies such as issues related to smoke free households and other health and social policy initiatives.
- **School-based intervention** – Well-designed school prevention strategies and programs that are known to be effective for children and that persist well into their adulthood.
- **Workplace interventions** – Programs and policies that will encourage behavioural change and create a safer and healthier work environment.
- **Community support** – Community-based and community-wide approaches that have been proven to hold the greatest promise in health promotion (International Union for Health Promotion and Education, 2000).

A Multi-Faceted Population-Based Approach to Prevention Programs in British Columbia

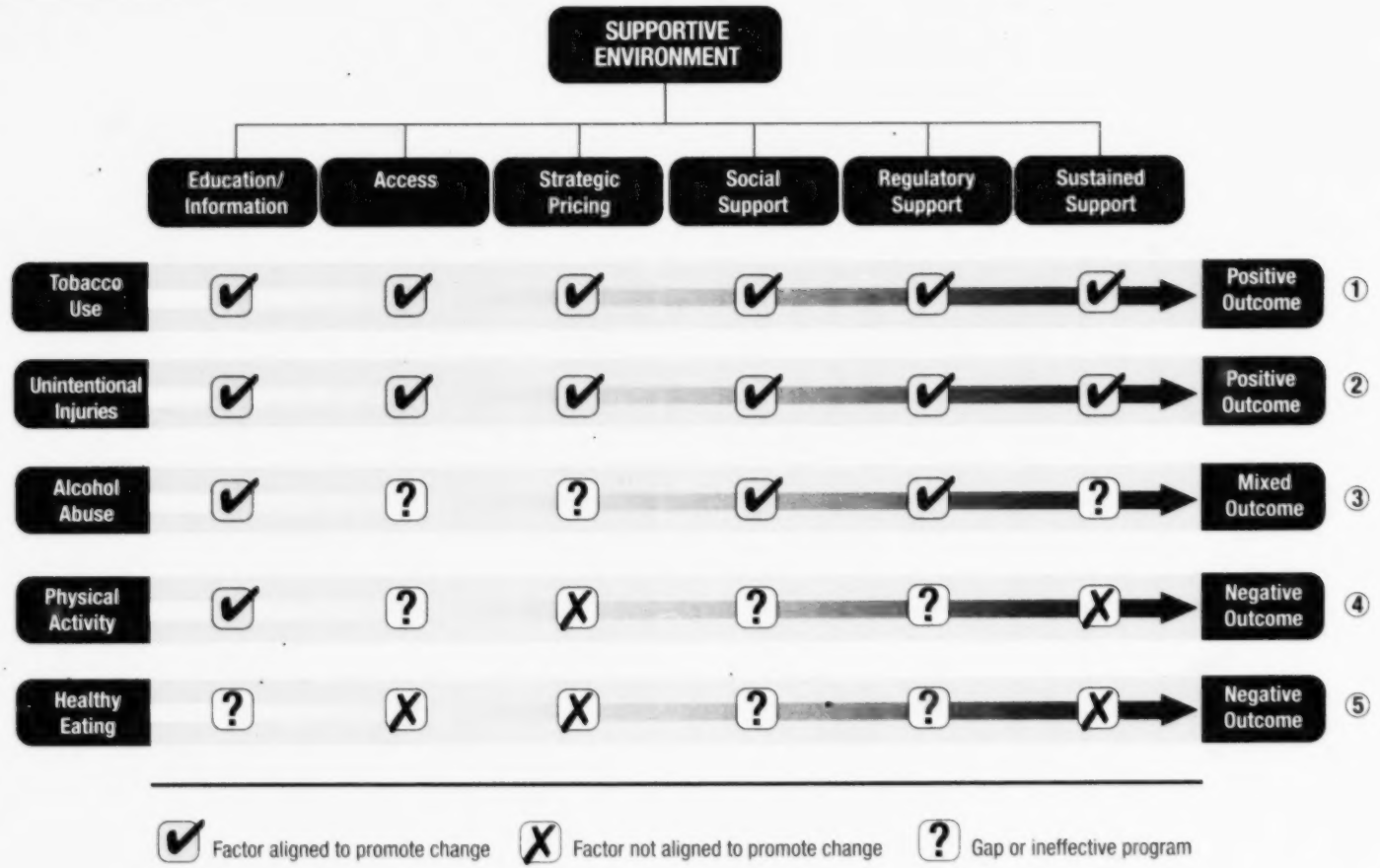
Figure 4.5 illustrates the results of a coordinated and multi-faceted approach to prevention programs such as reduction of tobacco use and unintentional injuries. Such an approach provides a supportive environment for the change through the following elements:

- **Education/Information** – Public information and educational programs.
- **Access** – Restriction or ease of access depending on the program intended.
- **Strategic pricing** – Affordability of the product or the program.
- **Social support** – Availability of environmental and community support.
- **Regulatory support** – Provision of the policies and regulation for the program.
- **Sustained support** – Resources and funding to maintain the program over a long-term period.

Similar to the results of the International Union for Health Promotion and Education research, the British Columbia experience has shown that with a combination of strategies employed simultaneously, it is possible to create a supportive environment and achieve a change in the behaviour of individuals that would result in a positive outcome for the population health and prevention programs. It is clear that the positive outcome of programs to reduce both tobacco use and unintentional injuries (Figure 4.5) were a result of the alignment of all the elements. Figure 4.5 further illustrates that when there is a gap in the provision of the elements, such as for alcohol abuse, physical activity, and healthy eating, there is generally no measurable improvement and in some cases a negative outcome.

The Ministry of Health has launched prevention and wellness programs with a population-based focus and effective multi-faceted strategies. Examples of these programs include Action Schools! BC, ActNow BC, BC Chronic Disease Framework, and the BC Nutrition Survey. The majority of these programs focus on healthy eating, increasing physical activity, decreasing tobacco use, and decreasing overweight and obesity.

Figure 4.5 Coordinated Prevention Strategies in British Columbia



1. Lowest ever smoking rate.
2. Fifty per cent reduction in unintentional injury death rates.
3. Data show increased alcohol intake and binge drinking episodes by youth, but also a decline in alcohol-associated mortality.
4. In 2003, the overall rate of physical inactivity was 41 per cent in British Columbia.
5. In 2003, 48 per cent of individuals in British Columbia, considered themselves overweight or obese.

Prevention and Wellness Programs in British Columbia

Action Schools! BC

Action Schools! BC is a best-practice physical activity model designed to assist schools in promoting healthy living. It provides more opportunities for more children to be more physically active, more often. The Action Schools! BC initiative was piloted in 10 Lower Mainland schools (Grades 4 to 7) for 17 months between February 2003 and June 2004. The pilot evaluation demonstrated positive results that led to the expansion of the initiative. On average, pilot schools provided 49 more minutes per week of physical activity than usual/control schools. This resulted in the intervention schools reaching or exceeding the goal of 150 minutes of physical activity per week. At the end of the study, children in the pilot schools recorded an average 10,000 steps per day versus an average 9,000 steps per day for the control schools—a 10 per cent increase in physical activity compared to baseline data. Children in the pilot schools improved aerobic fitness by 39 per cent compared to 17 per cent for children in usual practice schools.

The provincial roll out (Grades 4 to 7) which began September 2004, is phased over a three-year period. Kindergarten to Grade 3 and Middle School models are currently being developed.

ActNow BC

The provincial government is partnering with the BC Healthy Living Alliance, and 2010 LegaciesNow, to develop a coordinated approach to reduce common risk factors for chronic diseases, including diabetes.

Introduced in March 2005, ActNow BC combines cross-government and community-based approaches to address common chronic disease risk factors through programs and initiatives that support healthier eating, physical activity, reducing tobacco use, and promoting healthy choices during pregnancy. ActNow BC is guided by the following targets:

Tobacco Use

To continue BC's downward trend of tobacco use by a further 10 per cent from the current level of 16 per cent to a target prevalence rate of 14.4 per cent in 2010.[3]

Healthy Eating

To increase the daily recommended level of fruit and vegetables by 20 percent from the current level of 40 per cent to a target level of 48 per cent by 2010.[4]

Physical Activity

To increase the proportion of the BC population who are moderately physically active during their leisure time by 20 per cent from a current level of 58 per cent to a level of 69.6 percent by 2010.[5]

Overweight and Obesity

To reduce the proportion of the BC population currently classified as obese or overweight by 20 percent from the current prevalence rate of 42.3 percent to 33.9 percent by 2010.[6]

Fetal Alcohol Spectrum Disorder (FASD)

To increase the number of women counselled regarding alcohol use during pregnancy by 50 percent and strive to have focused FASD prevention strategies for all Health Authorities by September 2006.[7]

ActNow BC is not intended to replace the many successful programs and activities that are already in place. Instead, it is meant to provide a coordinated approach to promote a

[3] *Source: age group 15 years and older: Canadian Tobacco-Use Monitoring Survey (2003).*
[4] *Source: daily fruit and vegetable consumption - age group 12 years and older: Canadian Community Health Survey (CCHS), Statistics Canada (Vol. 2004, No. 1).*
[5] *Source: leisure-time physical activity - age group 12 years and older: Canadian Community Health Survey, Statistics Canada (Vol. 2004, No. 1).*
[6] *Source of obesity data: age group 18 and over, excluding pregnant women: Canadian Community Health Survey, Statistics Canada (Vol. 2004, No 1). Obesity defined as BMI of 30.0 or higher, overweight defined as BMI 25 to 29.9.*
[7] *Target established in consultation with Nancy Poole, Research Network – BC Women's Hospital and Health Centre.*

healthy lifestyle. ActNow BC aims to make BC one of the healthiest jurisdictions ever to host the 2010 Olympic and Paralympic Games (MOHS, 2005).

Chronic Disease Framework

The Ministry of Health is addressing the issue of chronic disease in a two-pronged approach: chronic disease prevention and chronic disease management. The Chronic Disease Prevention Framework, distributed in September 2003, provides an overview of the factors that lead to chronic diseases and the range of interventions needed to prevent or reduce their occurrence. The main focus of the Chronic Disease Framework is to develop initiatives that would focus on a selected set of chronic conditions (heart disease, cancer, chronic respiratory disease, and diabetes) that share common risk factors (tobacco use, unhealthy eating, and physical inactivity). The Framework provides the structure for identifying broad and generic strategies for addressing these chronic conditions, and more disease or condition-specific strategies (MOHP, Population Health and Wellness, October 2003). The provincial government has since established the comprehensive ActNow BC initiative, which focuses on the prevention of chronic diseases and conditions by addressing common risk factors.

BC Nutrition Survey

The Ministry of Health has prepared four reports on the findings and implications of the 1999 BC Nutrition Survey: Nutrient Intake, Food Group Consumption, Seniors' Issues, and Physical Activity. The findings provide current information to inform policy and program decisions related to nutrition, physical activity, and obesity.

Secondary Prevention

Secondary prevention involves early diagnosis of Type 2 diabetes and delaying the progress of the disease (Last, 1980). Factors that need to be considered in secondary prevention of Type 2 diabetes are: cost-effective methods

Good Food Box

It can often be a challenge for people on low incomes to afford high quality, nutritious foods. The Good Food Box is a community-based program designed to ensure that people on low incomes have access to high quality fruits and vegetables. The concept of the Good Food Box came from Brazil, and the first program in Canada started in Toronto. Many communities have adapted the Toronto model, which uses a central warehouse and distribution points throughout the city.

In BC, Good Food Box programs can be found throughout the province. They focus on buying local, in season, BC produce whenever possible, to support local farmers. The boxes contain fruits and vegetables to promote healthy eating, and encourage sustainable farming practices by buying organic when possible.

Access to nutritious food is one of the ways in which we can improve health, and the Good Food Box programs throughout BC are helping to ensure that British Columbians have access to good food.

Sources: Kneen, C. (2004, January). *The good food box. A handbook for British Columbia.* British Columbia: BC Food Systems Network. Retrieved February 7, 2005, From http://www.vcn.bc.ca/gfb/downloads/BC%20handbook.pdf

Welcome to the Good Food Box! (n.d.) Retrieved February 7, 2005, from http://www.vcn.bc.ca/gfb/index.php

of screening and treatment, and sufficient, appropriate, and organized resources to deliver both screening and treatment.

A report by the chief medical health officer of Ontario concluded that because of the relatively low overall rate of diabetes in the general population, mass screening is not cost-effective. However, targeted screening for Type 2 diabetes among individuals with risk factors is recommended. These risk factors include:

- Overweight and Obesity
- Age 40 and older
- A close relative with diabetes
- Member of a high-risk ethnic group
- A history of glucose intolerance
- A previous diagnosis of gestational diabetes
- High blood pressure
- Cholesterol abnormalities
- The presence of diabetes-related complications

Similar recommendations have been published by the Canadian Diabetes Association. In addition, recommendations on screening adults with hypertension have also been published by the US Preventive Services Task Force (2003).

A US study estimated the cost-effectiveness of screening for Type 2 diabetes using a computer model. The study concluded that early detection and treatment would result in the postponement of diabetes complications and improvements in the quality of life. The costs of screening and early treatment were also found to be within the range of acceptable cost-effectiveness for US health care systems, especially for those younger adults who are at high-risk of developing complications from Type 2 diabetes (CDC Diabetes Cost-Effectiveness Study Group, 1998).

Canadian Diabetes Strategy

In 1999, the federal government pledged $115 million over five years for the development of a Canadian Diabetes Strategy. The purpose of the strategy was to establish effective prevention and control strategies for diabetes in Canada. The four components of the strategy are:

- **National Diabetes Surveillance System (NDSS) –** Focusing on providing improved data about diabetes, the NDSS is a network of regionally distributed diabetes surveillance systems that compile administrative health care data related to diabetes and provide aggregate anonymous data to Health Canada for national analyses.
- **Prevention and Promotion Programs** – The prevention and promotion programs are specific initiatives for the creation of an effective diabetes prevention and control strategy for Canada.
- **Aboriginal Diabetes Initiative** – A special program that is intended to decrease diabetes and its complications among First Nations peoples.
- **National Coordination** – The National Coordination Program coordinates the work of stakeholders to ensure duplication does not occur and resources are used effectively.

In Summary

- Diabetes is considered to be one of the more prevalent of all chronic diseases worldwide. The prevalence of diabetes is increasing in British Columbia. It is estimated that 4 out of 10 people with diabetes will develop complications such as blindness, kidney disease, cardiovascular disease, amputation, and reduced life expectancy (McParland, 2002).
- Methods of preventing Type 2 diabetes are categorized into primary (actions to prevent the development of diabetes), secondary (early diagnosis and retarding the progress) and tertiary (minimizing the effects of diabetes by management of its complications).

- In general, there are two approaches to primary prevention of Type 2 diabetes: the high-risk approach and the population-based approach. The high-risk approach focuses on individuals at high risk of developing diabetes, while the population-based approach focuses on the whole population.
- The Ministry of Health has launched prevention and wellness programs with a population-based focus. Examples of these programs include Action Schools! BC, ActNow BC, BC Chronic Disease Framework, and the BC Nutrition Survey. The majority of these programs focus on healthy eating, increasing physical activity, decreasing tobacco use, and decreasing overweight and obesity.
- Studies have shown that obesity and physical inactivity are major risk factors for developing Type 2 diabetes and that lifestyle programs that would change these factors could be effective for those who are at early stages of developing diabetes (IGT stage).
- For prevention programs to be successful, governments and communities need to work together to provide effective, aligned, multi-sectoral interventions as well as committed resources and funds to maintain these programs over long periods of time.

Auditor General's View on Primary and Secondary Prevention Programs for Diabetes

In 2004/2005, the Auditor General of British Columbia released *Preventing and Managing Diabetes in British Columbia*. In this report, the Auditor General indicated that, in general, prevention strategies are easier to introduce than to fully implement. Research has shown that despite public education programs, excess weight, obesity and physical inactivity are still increasing among children and into adulthood. Therefore, primary prevention programs require a comprehensive approach to change social norms and patterns. In changing these patterns, many factors such as level of education, lack of economic means, poor access to recreation facilities, depression and low self-esteem, social status, and individual control and power need to be addressed.

According to the Auditor General, most primary prevention programs to date have shown limited success due to a lack of committed resources and funding over a period of time necessary for the program to be effective. For example, many school intervention programs have only concentrated on making internal changes within the schools but are not extended to community-wide, out-of-school, and population-based initiatives, and too frequently parents are not involved in changing patterns outside of schools to complement what is occurring during school hours. The Auditor General concluded that for primary prevention programs to be successful, a multiple and coordinated intervention strategy is necessary.

Further, the Auditor General recommended that for secondary prevention programs to be successful the methods of screening and treatment must be cost-effective, and the resources needed to deliver these treatments have to be sufficient and appropriate. Although some education and support programs have been provided through education centres such as Prince George to support those individuals diagnosed with diabetes, to date, no organized province-wide programs have been developed that would directly focus on detection or treatment of people at the initial stages of diabetes (IGT stage).

The Auditor General's report concludes that for a prevention program to be successful, a concentrated effort between federal and provincial governments is necessary. This success will depend on the availability of resources to provide effective primary and secondary treatment programs, as well as the commitment to maintain these programs for long periods of time (Auditor General of British Columbia, 2004).

HEAL
Healthy Eating and Active Living in Northern British Columbia

Healthy Eating and Active Living (HEAL) in Northern British Columbia is a three-year initiative funded by Health Canada and administered by the Northern Health Authority. HEAL is a network of individuals, organizations, and communities from 100 Mile House to the Yukon border, working together to prevent Type 2 diabetes through the promotion of healthy eating and active living. Vast distances often separate the communities of the North, and social and economic barriers exist which can make program implementation a challenge. In response, HEAL uses a grassroots, community-led approach to their work, and is supported by a coalition of health professionals, food growers, educators, recreation leaders, community activists, and others committed to healthy eating and active living.

In their first year, HEAL's projects were very hands-on. They provided seed funding for 15 community projects that included community gardens, community kitchens, walking trails, and recreation programs. These initiatives helped to reduce barriers to good food and physical activity.

In their second year, HEAL supported projects that focused more on long-term systemic change. Examples of these projects include:

- WorkWell – a coalition of five service agencies that have made healthy eating and active living a part of their everyday life.
- School Food and Nutrition Policy – Four schools in the Cariboo Chilcotin School District designed their own policies to make healthy choices the easy choices.

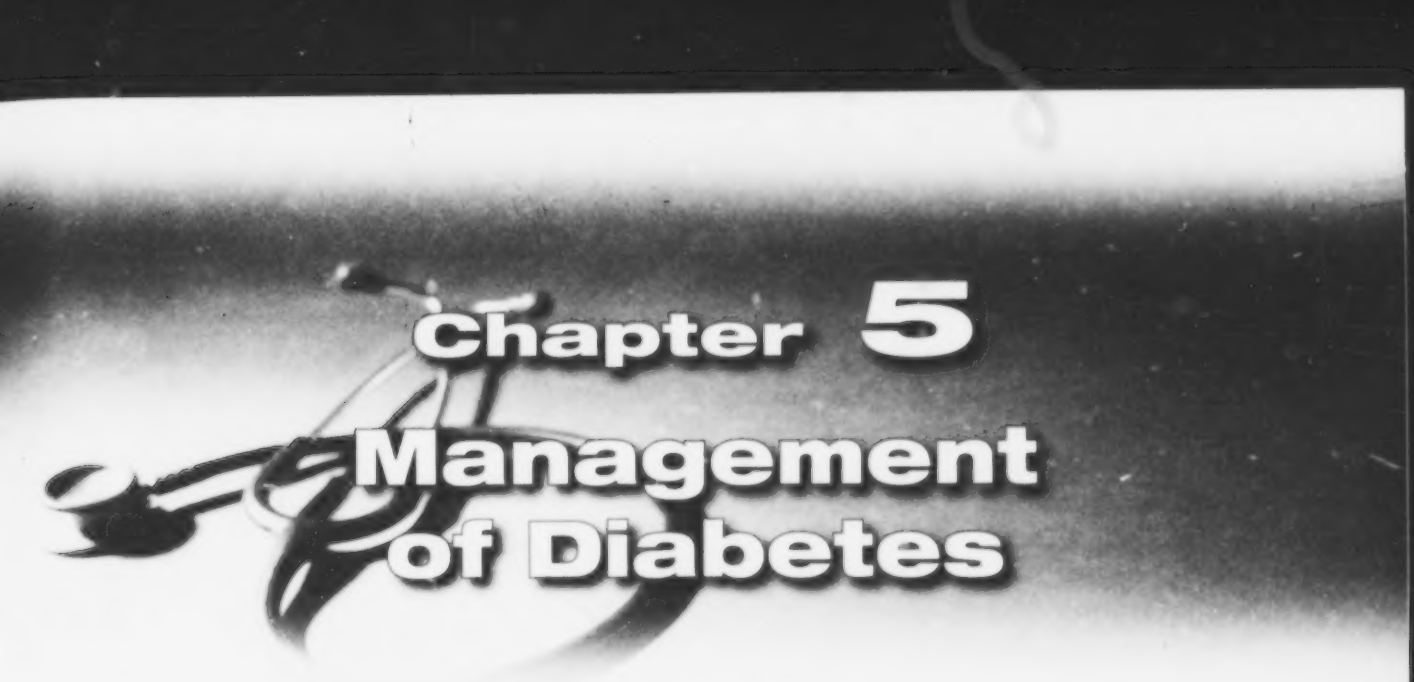
To celebrate the role models from these community initiatives, HEAL started a HEAL Heroes award. Recipients include organizations and individuals, such as a woman who launched a Good Food Box program or a man who involved people recovering from addictions in work to reclaim land for gardens.

HEAL has shown successfully how challenges such as geography, climate, and economics can be overcome through determination and commitment to making the healthy choices the easy choices. For more information on HEAL, please refer to their website at www.healbc.ca

Source: Health Canada. (2004, October). *Communities act! Making change happen: Stories from British Columbia diabetes projects.* Vancouver, BC: Health Canada.

Dietitians of Canada, BC Region, & Community Nutritionists Council of BC. (2003, October). *The Cost of Eating in BC.* Vancouver, BC: Dietitians of Canada, BC Region & Community Nutritionists Council of BC.

Healthy Eating & Active Living. (n.d.). Retrieved February 1, 2005, from www.healbc.ca.



Chapter 5
Management of Diabetes

Management of diabetes (sometimes called tertiary prevention) entails delaying or preventing the development of complications from Type 2 diabetes and managing them once they occur. Once an individual is diagnosed with diabetes, the treatment should focus on reducing blood glucose levels towards normal range to reduce the risk of microvascular complications (kidney disease, eye disease, and amputation). It is also important to note that early identification and treatment of complications and co-morbidities are essential.

The management of Type 2 diabetes can be complex, as many patients require a combination of medical interventions and lifestyle changes to control their blood glucose levels. Type 2 diabetes patients are frequently older and have other diseases that require medical care to avoid further complications (Coulston, 2001).

Research in Managing Diabetes

As mentioned in Chapter 4 of this report, based on Canadian Community Health Survey (CCHS) data, approximately 69 per cent of all those who have Type 2 diabetes in British Columbia are overweight or obese. Several organizations including the American Diabetes Association have put this figure at 80 to 90 per cent (McParland, 2002). Findings of recent clinical trials have concluded that the risk of developing Type 2 diabetes can be reduced with appropriate diet and exercise. Exercise and restriction of food intake can improve glucose tolerance and decrease insulin resistance as well as improve coronary risk factors in many patients with established Type 2 diabetes.

Two comprehensive studies in this field include a 10-year longitudinal study by the United States National Institute of Diabetes and Digestive and Kidney Diseases, which found that patients who were able to monitor and control blood sugar levels were also able to slow the onset of eye, kidney, and nerve diseases resulting from diabetes. In 1977, the United Kingdom Prospective Diabetes Study (UKPDS) examined people with Type 2 diabetes to see if any health improvements could be gained by intensively lowering blood glucose and blood pressure with pharmacological agents. Results announced in 1998 concluded that if people with Type 2 diabetes aggressively reduced their blood glucose (using insulin), they could reduce their risk of developing blindness and kidney failure by 25 per cent. If they had high blood pressure and worked aggressively to reduce it, they would lower their risk of stroke by 44 per cent and heart failure by 56 per cent (Diabetes Control and Complications Trial Research Group, 1993).

Management of Chronic Disease in British Columbia

Chronic disease management is an approach to health care that is designed to help individuals with chronic diseases manage their chronic conditions in such a way so that they can maintain independence and keep as healthy

as possible. With medical advice, lifestyle changes, and access to resources and services, patients will be better able to manage their chronic conditions. Chronic disease management in BC involves the collaboration of many medical and health care professionals, health authorities, researchers, and organizations. The aim of this initiative is to improve health status, achieve better clinical outcomes, improve cost efficiency and achieve better results for individuals and health care providers. The following list includes the organizations who are participating in this initiative:

- BC Ministry of Health
- BC Health Authorities
- Health Canada
- BC College of Pharmacists
- BC Pharmacy Association
- BC College of Family Physicians
- BC Medical Association
- College of Physicians and Surgeons of BC
- Registered Nurses Association of BC
- BC Association of Optometrists
- BC Society of Occupational Therapists
- University of British Columbia, Continuing Education, Faculty of Medicine
- University of Victoria, Chronic Disease Self-Management Program
- The Arthritis Society (BC and Yukon Division)
- BC Renal Agency
- BC Kidney Association
- Canadian Diabetes Association
- Heart and Stroke Foundation of BC/Yukon
- Canadian Mental Health Association (BC)
- Healthy Heart Society
- Individual health practitioners
- Canada's pharmaceutical companies
- Medical Services Commission

Important Areas of Concern for Diabetics in Managing Their Condition

- Blood glucose level
- Blood glucose control
- Cholesterol
- Kidneys
- Eyes
- Feet
- Nerve damage (neuropathy)
- Blood pressure
- Nutrition, diet, and weight
- Exercise

Source: Ministry of Health, Chronic Disease Management Branch, 2003 www.healthservices.gov.bc.ca/cdm/

Managing Diabetes in British Columbia

Medical studies have proven that many complications of diabetes can be delayed or prevented with good management and clinical care. Good management practices include control of glycemia, lipids, and blood pressure; and early detection and treatment of eye problems, damages to the kidney, and foot disorders. The Chronic Disease Management Branch of the Ministry of Health has established programs through *The Diabetes Care Guide*[1] which suggest that most diabetic patients should receive certain recommended services on a regular basis. The long-term target is 90 per cent of all individuals diagnosed with diabetes receiving these recommended services at the recommended frequency.

Chronic Care Model

The Ministry of Health has adopted an integrated approach to the management of all chronic diseases, including diabetes. In doing so, the government has chosen an expanded version of a chronic care model that was developed in the United States by the Group Health Cooperative of Puget Sound and the Institute for Healthcare Improvement. This model is well accepted and supported by many research groups.

[1] *The Diabetes Care Guide can be found at http://www.healthservices.gov.bc.ca/msp/protoguides/gpi/diabetes_care.pdf*

Figure 5.1 The Chronic Care Model

The Chronic Care Model was developed to provide a framework of best practices in managing chronic diseases. The model shows the areas of conventional practice that need to change, and identifies necessary changes to improve the system to support better health outcomes (MOHS, Chronic Disease Management, Chronic Care Model, 2004).

Community - Resources and Policies
• Coordination of resources for the benefit of patients and their families.
• Identifying and developing effective community-based programs to meet the needs of patients with chronic illnesses.
Build Healthy Public Policy
• Developing policies to improve population health through incorporation of legislation,fiscal measures, taxation, and organizational change.
COMMUNITY-RESOURCES & POLICIES
Public Policy
Community Action
Supportive Environments
Strengthening Community Action
• Working with community groups to set and achieve goals that benefit the health of the community.
• Encouraging public participation, to help people find their own ways, to manage the health of the community.
Providing Supportive Environments
• Generating living and working conditions that are safe, stimulating, and enjoyable.
• Implementing strategies that foster optimal levels of health in social and community environments.
Decision Support
• Trained practice teams.
• Integration of clinical practice guidelines into everyday practice.
• Involvement of specialists in decision support.
HEALTH CARE ORGANIZATION
Decision Support
Self-Management & Support
Information Systems
System Redesign
Self-Management & Support
• Emphasis on patient as the central role.
• Assigning resources to support management.
• Effective support strategies: assessment, goal-setting, action plans, problem-solving and follow-up.
Information Systems
• Population-based information system consisting of patient registries, patient recall and follow-up.
• Treatment plans that are established in cooperation with patient evaluation system.
• Built-in evaluation system to help improve the performance of the team of caregivers.
System Redesign
• Design of health care system with a focus on keeping individuals as healthy as possible.
• A team-based approach to care in which each provider has a specific role in providing care, planned visits, patient follow-up and proactive care.
• Case management for complex cases.
PRODUCTIVE INTERACTIONS & RELATIONSHIPS
Activated Community
Prepared Community
Informed Activated Patient
Prepared Proactive Practice Team
Population Health Outcomes/ Functional & Clinical Outcomes

Source: Adapted from *British Columbia's Expanded Chronic Care Model*, Ministry of Health, Chronic Disease Management, 2003.

Recommended Services Provided for Persons with Diabetes in British Columbia

A1C Test

A1C is a blood test that reflects overall blood glucose control and it measures the amount of glucose that is attached to a protein called hemoglobin in red blood cells. A1C is measured in percentage and can be compared to blood glucose levels. If the blood glucose levels are within the goal range of 4 to 7 mmol/L, then the A1C should fall between 4 to 6 per cent. Canadian Diabetes Association guidelines recommend that A1C should ideally be less than 6 or 7 per cent. (Stathers, 2005). The *Diabetes Care Guide* recommends that diabetes patients should receive four A1C tests every year.

Microalbumin Test

The microalbumin test measures the amount of a protein called microalbumin in the urine. When large amounts of substances such as microalbumin are present in the urine, there is an indication of kidney disease or kidney damage. An early detection of kidney disease will prevent further complications of the kidneys (Allina Hospitals & Clinics, 2005). The *Diabetes Care Guide* recommends that diabetes patients receive at least one microalbumin test every year.

Lipid (Cholesterol) Test

Cholesterol is a waxy substance found in the blood. An excess of this substance in the blood results in its accumulation in the arteries, causing blockages. Cholesterol is measured by a lab test called a cholesterol or lipid panel. This test shows total cholesterol, which is divided into: LDL (low-density lipoprotein) and HDL (high-density lipoprotein). LDL, called the 'bad' cholesterol, is the fat that builds up on the walls of blood vessels. HDL, or the 'good' cholesterol, acts as a vehicle to carry the LDL cholesterol away from the vessels back to the liver. In the liver, the cholesterol is broken down and removed from the body. Diabetes often causes higher LDL cholesterol and lowers the HDL cholesterol. Diabetes patients should receive at least one lipid test every three years (Stathers, 2005).

In addition to the above recommended services, persons with diabetes should receive eye exams and have their blood pressure checked and their feet examined for nerve damage on a regular basis. The recommended blood pressure for persons with diabetes is 130/80 (MOHS, Chronic Disease Management, Important Questions, 2004).

Figures 5.2 to 5.5 illustrate the proportion of persons with diabetes who received the recommended services between 1999/2000 and 2003/2004 in British Columbia. Although an increasing proportion of persons with diabetes are receiving the recommended services, more diabetics should be provided with the opportunity to receive these services on a regular basis. Research has shown that with the testing and monitoring of the above and changes in lifestyle involving diet and physical activity, it is possible to reduce the risk of complications associated with diabetes and keep diabetic patients as healthy as possible.

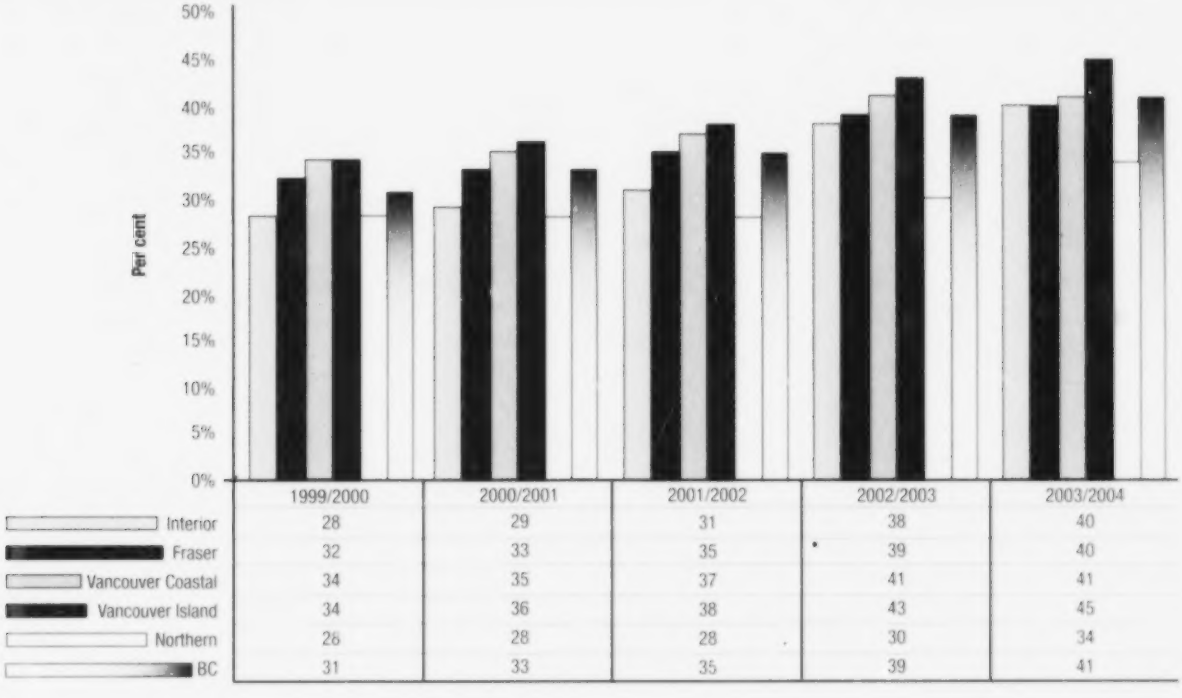
Chronic Disease Management Publications and Services

The 2002 report from the Diabetes Working Group in BC entitled *Improving Chronic Disease Management*, provided an evidence-based cost-benefit analysis demonstrating the cost savings accrued by improving health outcomes through better diabetes care and self-management. This resource enables more effective decision-making by government regarding health services for people with diabetes. *The Diabetes Care Guideline* from the BC Guidelines and Protocols Advisory Committee[2] provides evidence-based information to physicians on optimal diabetes care, identifying which services should be provided on a regular basis.

The Ministry also produces the annual document *A Snapshot of Diabetes Care in British Columbia*, which provides information on performance across the primary care system in meeting the standards of care. For more information please consult the Chronic Disease Management website (http://www.healthservices.gov.bc.ca/cdm/).

[2] *Jointly sponsored by the British Columbia Medical Association and the Ministry of Health (MOHS, Medical Services Plan, 2005).*

Figure 5.2 Proportion of Persons with Diabetes Receiving A1C Tests, BC, 1999/2000 to 2003/2004

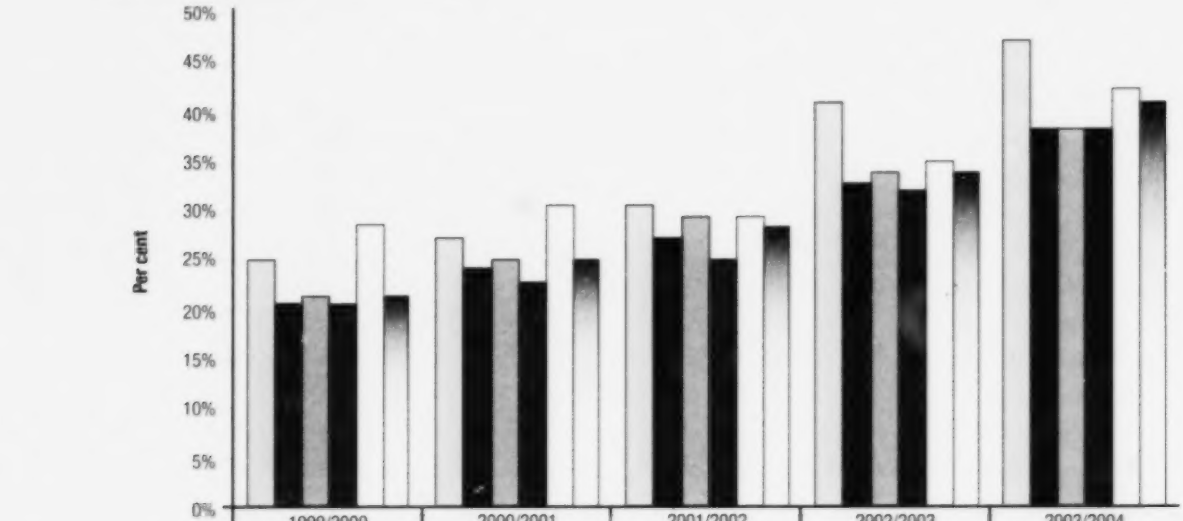


	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004
Interior	28	29	31	38	40
Fraser	32	33	35	39	40
Vancouver Coastal	34	35	37	41	41
Vancouver Island	34	36	38	43	45
Northern	26	28	28	30	34
BC	31	33	35	39	41

Source: Chronic Disease Management, Ministry of Health, 2005.

Figure 5.2 illustrates the proportion of persons with diabetes who received A1C tests between fiscal years 1999/2000 and 2003/2004. Although the proportion of those receiving the test has increased in all Health Authorities since 1999, the levels still remain below 50 per cent in 2003/2004. Overall, those in the Vancouver Island Health Authority received the highest proportion of A1C tests (45 per cent) while those in the Northern Health Authority received the lowest proportion (34 per cent). The overall BC rate for A1C tests increased from 31 per cent in 1999/2000 to 41 per cent in 2003/2004.

Figure 5.3 Proportion of Persons with Diabetes Receiving Microalbumin Tests, BC, 1999/2000 to 2003/2004

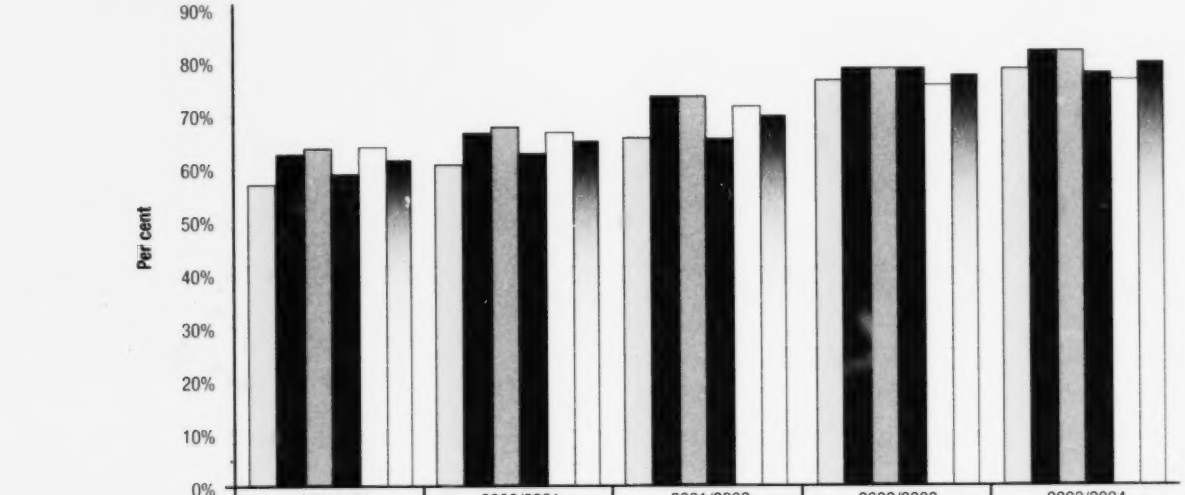


	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004
Interior	25	27	31	41	47
Fraser	21	24	27	33	39
Vancouver Coastal	22	25	29	34	39
Vancouver Island	21	23	25	32	39
Northern	28	31	29	35	42
BC	22	25	28	34	41

Source: Chronic Disease Management, Ministry of Health, 2005.

Figure 5.3 illustrates the proportion of persons with diabetes who received microalbumin tests between fiscal years 1999/2000 and 2003/2004. In 2003/2004, the Interior Health Authority had the highest proportion of persons with diabetes who received microalbumin tests, at 47 per cent. On average, less than 50 per cent of all persons with diabetes in all Health Authorities received microalbumin tests between 1999/2000 and 2003/2004. The overall BC rate for microalbumin tests increased from 22 per cent in 1999/2000 to 41 per cent in 2003/2004.

Figure 5.4 Proportion of Persons with Diabetes Receiving Lipid Tests, BC, 1999/2000 to 2003/2004

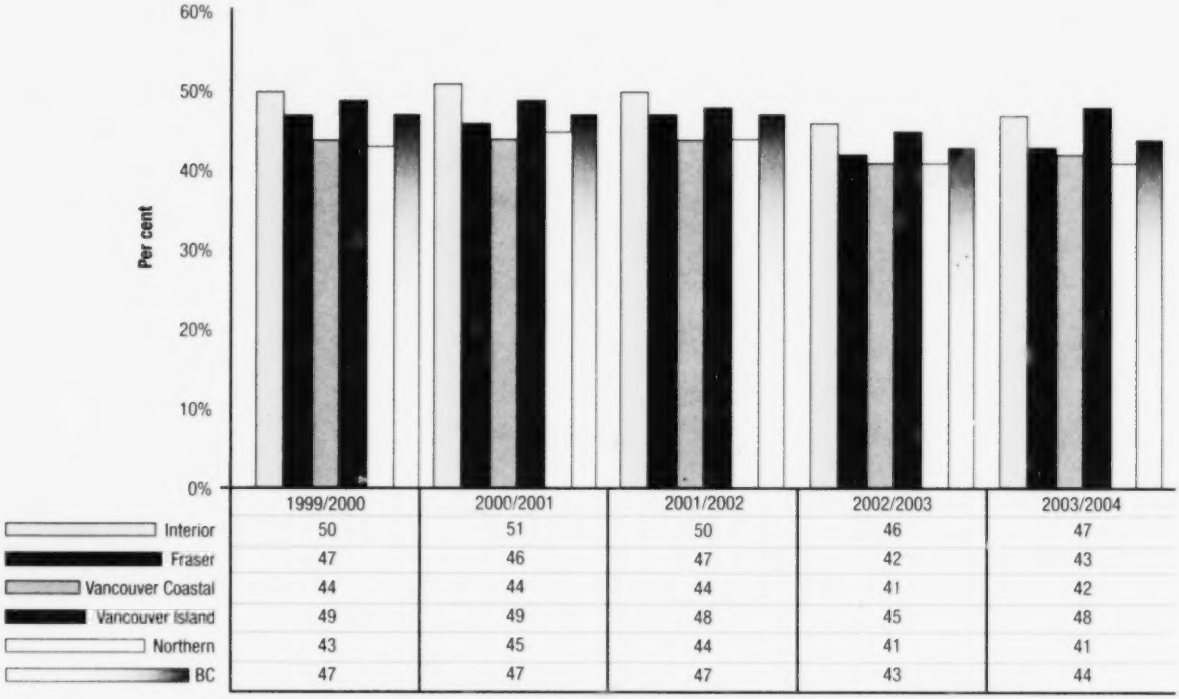


	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004
Interior	57	61	66	77	79
Fraser	63	67	72	79	81
Vancouver Coastal	64	68	72	79	81
Vancouver Island	59	63	68	79	78
Northern	64	67	71	76	77
BC	61	65	70	78	80

Source: Chronic Disease Management, Ministry of Health, 2005.

Figure 5.4 indicates the proportion of persons with diabetes who received lipid tests between fiscal years 1999/2000 and 2003/2004. During this period, over 75 per cent of persons with diabetes received the recommended lipid tests. The overall BC rate for lipid tests increased from 61 per cent in 1999/2000 to 80 per cent in 2003/2004.

Figure 5.5 Proportion of Persons with Diabetes Receiving Eye Exams, BC, 1999/2000 to 2003/2004



	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004
Interior	50	51	50	46	47
Fraser	47	46	47	42	43
Vancouver Coastal	44	44	44	41	42
Vancouver Island	49	49	48	45	48
Northern	43	45	44	41	41
BC	47	47	47	43	44

Source: Chronic Disease Management, Ministry of Health, 2005.

Figure 5.5 illustrates the proportion of persons with diabetes who received eye exams in BC between fiscal years 1999/2000 and 2003/2004. Vancouver Island and Interior Health Authorities had the highest proportion of persons with diabetes who received eye exams in 2003/2004. Between 1999/2000 and 2003/2004 approximately less than half of persons with diabetes received eye exams in all Health Authorities. The overall BC rate for eye exams decreased from 47 per cent in 1999/2000 to 44 per cent in 2003/2004.

Dial-A-Dietitian

Dial-A-Dietitian is an organization dedicated to providing "readily accessible quality nutrition information to the public and health information providers throughout British Columbia." (Dial-A-Dietitian Nutrition Information Society, 2004). In interviewing people newly diagnosed with Type 2 diabetes on what they had learned about eating for their condition, they found that there was no standard, recognizable source of information on eating for diabetes.

As a result, they started a stakeholder group that included representatives from the groups or professionals consulted by people with Type 2 diabetes: physicians, librarians, pharmacists, dietitians, and the Canadian Diabetes Association. This group suggested the development of a simple, one-page print and/or on-line education resource for people with diabetes. The resource would include consistent messaging about eating for diabetes, and contact information for additional resources. The group recommended that the resource be widely available; for example, in physicians' offices, public libraries, pharmacies, health units, and diabetes education centres.

Partners in this project included the Canadian Diabetes Association, the Ministry of Health, BC College of Family Physicians, BC Pharmacy Association, and Dietitians of Canada. Two existing print resources were adapted to create an education resource that could be distributed by physicians at the time of diagnosis, and that could be available online. The information sheet included "Getting Started," which gives tips on healthy eating until you talk with a registered dietitian, and "Diabetes Resources: A Guide to Services For People With Diabetes." The "Getting Started" information sheet is BC Health File #70 Diabetes: Getting Started. This Health File can be found at http://www.bchealthguide.org/healthfiles

The information sheet was distributed to a sample of people newly diagnosed with Type 2 diabetes. Feedback from this sample group indicated that they valued the information contained in the sheet. Some had already been in contact with some of the diabetes services; those who had not still valued knowing what services were available, indicating that not having information was what produced anxiety.

Dial-a-Dietitian provides nutrition and special diet information, advice, and referral services. You may call and speak with a registered dietitian about healthy eating for diabetes between 9 a.m. and 5 p.m. Monday to Friday. For information, visit www.dialadietitian.org, or call: Within Greater Vancouver, call 604-732-9191; Within BC, call toll-free 1-800-667-3438. Translation services are available in 130 languages.

Sources: Health Canada. (2004, October). *Communities act! Making change happen: Stories from British Columbia diabetes projects.* Vancouver, BC: Health Canada.

Ministry Projects in Support of Better Management of Diabetes

Diabetes Collaborative

The Diabetes Collaborative is a joint project between the BC Medical Association and the Ministry of Health. The goal of this collaborative is to build a system to maximize the length and quality of life for chronic disease patients, while maintaining or even decreasing the cost of health care. This system aims to improve the interaction between health care providers and patients. One of the Diabetes Collaborative's first activities has been to test the latest BC Clinical Guidelines for Diabetes.

Patient Registry and Recall System

The Ministry of Health has developed a registry of people with diabetes through a review of Medical Services Plan, PharmaCare, Pharmanet, and hospital records for evidence of health care services relating to diabetes. The data collected is used by physicians who can access information through a secure web connection. The Patient Registry and Recall System is being expanded to provide a recall and reminder service so that physicians can note which patients are not coming for regular visits and remind them to do so.

Chronic Disease Self-Management Courses

The Ministry of Health has collaborated with the Centre on Aging, University of Victoria, to train individuals to give chronic disease self-management courses in each of the health authorities. These courses are highly structured and are led by trained volunteers who themselves have a chronic condition. Topics covered include: problem-solving, communicating effectively with health care professionals, and evaluating treatment options, as well as managing pain and stress and developing coping skills.

Chronic Care Practice Enhancement Incentive Project

The Chronic Care Practice Enhancement Incentive Project involves a group of participating family physicians who wish to develop and use patient care plans that are consistent with the BC Clinical Guidelines for Diabetes. Participating physicians receive an annual fee for each patient with a confirmed diagnosis of diabetes whose clinical management is consistent with the recommendation outlined in the guidelines. Originally a pilot project in 2002, the Chronic Care Practice Enhancement Incentive Project was evaluated under the direction of the General Practice Services Committee with representation from the BC Ministry of Health, BC Medical Association and the Society of General Practitioners of BC.

Health Authority Initiatives

In addition to partnering with the provincial government in projects, health authorities are also involved in their own pilot projects. Examples of these include:

- The Vancouver Island Health Authority has established an umbrella group called DO-It (Diabetes Outcome Improvement Team) that has sponsored a series of improvements in diabetes care.
- The Interior Health Authority is piloting two chronic disease centres in the Okanagan that will integrate educational and lifestyle services for people with diabetes, heart disease, or kidney disease.
- The Vancouver Coastal Health Authority has three pilot projects of interest. The first is a collaborative project with an adult daycare centre to provide better management and monitoring for those with diabetes. The second is a project where case managers coordinate the services provided to people by the health authority. Finally the health authority is working with a local community recreation centre to develop a wellness program for those who have chronic conditions, with a particular focus on diabetes.

BC HealthGuide Program

The BC HealthGuide Program is an innovative self-care/tele-care program aimed at enhancing consumer access to timely and accurate health information, expanding consumer knowledge, and reducing health system pressures due to inappropriate use.

The Program provides high quality health information and triage advice to BC residents to help them manage their personal health risks and conditions, take action appropriate to their health problem, and to participate more actively in decision making with their health providers. Its comprehensive approach to self-care and self management is unique in Canada and is based on information delivered through four components:

- **BC HealthGuide Handbook** – Provides important information on a range of health topics. The BC First Nations Health Handbook—a companion to the *BC HealthGuide*—is also available and provides specific information on health services available to aboriginal communities.
- **BC HealthGuide OnLine** – www.bchealthguide.org
- **BC NurseLine** – toll-free 24 hours a day, 7 days a week nursing triage and health education by telephone. Callers can speak to a pharmacist on medication-related issues between 5:00pm and 9:00am, every day.
- **BC HealthFiles** – a series of over 180 one-page, easy-to-understand fact sheets about a wide range of public and environmental health and safety issues.

As a platform for health system redesign, the BC HealthGuide Program is exploring ways to leverage BC NurseLine and other components to support chronic disease management. One initiative involves a partnership with Fraser Health Authority and Northern Health Authority to develop and evaluate the feasibility of a tele-health model for nurses or pharmacists providing self-management support to people with diabetes or congestive heart failure in collaboration with primary health care teams. Evaluation results will be available in 2006 (MOHS, BC HealthGuide Program, 2005).

Primary Health Care

Primary health care takes place at the first point of contact with the health system—often in doctors' offices, health clinics, or community health centres. Today, most experts agree that a primary care system should include the following features:

- Group medical practice, where physicians and other health professionals work together as a team.
- Contracts that establish service standards such as regular office hours, extended office hours, and 24-hour availability of medical care through sharing of on-call duties.
- A rostering process, such that each patient is registered primarily with one group practice.
- Access to a wide range of health services, including prevention, education and counselling, screening, emergency care, management of acute and chronic illness, and continuing care services.
- Information systems that help to better organize and manage patient information and that permit performance measurement and accountability.
- Funding that is based on the number and medical needs of a region's population.
- Payments to group practices based on their population of patients, rather than the volume of services they provide.
- Requirements or incentives that encourage quality care, such as bonuses for achieving high immunization rates, setting and achieving health goals, and audit processes.

Physicians play a central role in primary care. In British Columbia, the provincial government pays most physicians on a fee-for-service basis. This means that most physicians are independent businesses; they bill the government for the volume of services they have provided, and the provincial government acts as the reimbursement agency. Fee-for-service arrangements are not necessarily

the best way to encourage prevention efforts as they do not reward complex and team-oriented care. Although the majority of doctors are currently paid on a fee-for-service basis, fewer than half (49 per cent) indicate that this is their preferred method of remuneration (Sullivan & Buske, 1998).

Many studies have also recommended that primary health care should be transformed to allow doctors to work closely with other primary health care providers in a team setting. This would allow the doctors to focus on areas where their specialized skills can best be deployed (e.g., diagnosis) while supporting them with other health care providers in areas such as prevention, counselling, and self-management. It is also evident that primary care needs to be supported by an electronic system and health records that will provide up-to-date information on all patients to the team of health care providers (Millar, 2005).

Primary Health Care Renewal

Funded by Health Canada's Primary Health Care Transition Fund, Primary Health Care Renewal supports health authorities to develop and deliver a comprehensive and accessible range of primary health care services in their regions. Primary Health Care Renewal is a multi-faceted strategy designed to strengthen access to primary health care services, increase provider and patient satisfaction, and achieve measurable improvements in health outcomes with a focus on chronic disease management. It is centred on a strategic partnership between BC's health authorities and the Ministry of Health, with a goal of developing and delivering a more comprehensive and accessible range of primary health care services.

In terms of diabetes, the data clearly show that in most cases, with the exception of lipid testing, the majority of persons with diabetes are not receiving the recommended services that were set out in the *Diabetes Care Guide*. This in part is a reflection of the way that primary health care is currently organized and delivered in the province.

Successful Management of Diabetes

The responsibility for addressing the growing burden of diabetes rests with all partners and stakeholders. Success requires a sustained effort to collaborate, integrate, and innovate on a comprehensive range of initiatives. The vision of decreased human and financial burden of all forms of diabetes and its complications, and decreased incidence of diabetes is achievable through:

- Healthy communities that enable all British Columbians, including individuals with diabetes, to enjoy healthy living;
- Supportive environments that enable effective self-care and enhanced quality of life for people affected by diabetes; and
- Effective and efficient health services that balance best practice and innovation to foster primary, secondary, and tertiary prevention of diabetes (MOHP & MOHS, 2002).

In Summary

- Diabetes management (sometimes called tertiary prevention) entails preventing and managing the development of complications from Type 2 diabetes. Once an individual is diagnosed with diabetes, the treatment should focus on reducing blood glucose levels towards normal range to reduce the risk of microvascular complications (kidney disease, eye disease, and amputation).
- In BC, data show that approximately 69 per cent of those who have Type 2 diabetes are overweight or obese. Findings of recent clinical trials have concluded that the risk of developing Type 2 diabetes can be reduced with appropriate diet and exercise. Exercise and restriction of food intake can improve glucose tolerance and decrease insulin resistance as well as improve coronary risk factors in many patients with established Type 2 diabetes.

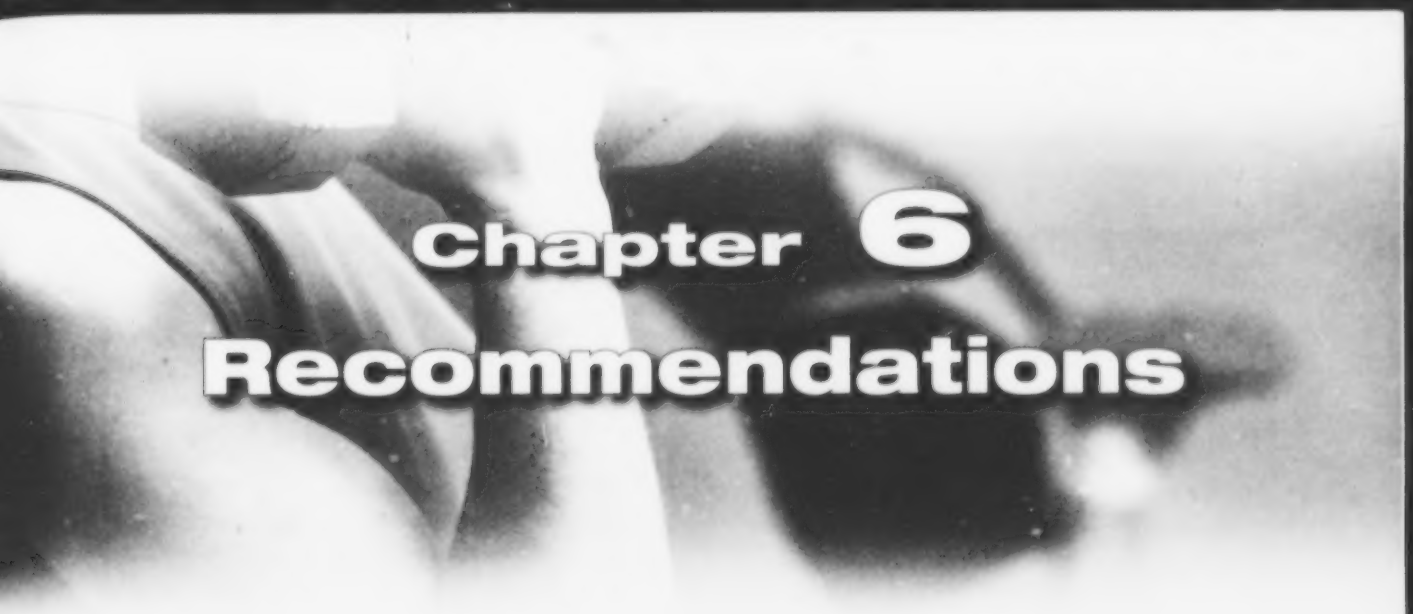
- The Chronic Disease Management Branch of the BC Ministry of Health has established that good management practices of diabetes should include control of glycemia, lipids, and blood pressure; and early detection and regular treatment of eye problems, diseases of the kidney, and diseases of the feet.
- Evaluation of data in BC clearly shows that with the exception of lipid testing, more than half of those with diabetes are not receiving the recommended services. This in part is a reflection of how primary care is organized and delivered in the province.
- Responsibility for addressing the growing burden of diabetes rests with all partners and stakeholders. Success requires a sustained effort to collaborate, integrate, and innovate on a comprehensive range of initiatives. Managing diabetes should involve all partners and stakeholders with the vision that a reduction in the human and financial burden of all forms of diabetes and its complications can be achieved through:
  - Healthy communities that enable all British Columbians, including individuals with diabetes, to enjoy healthy living;
  - Supportive environments that enable effective self-care and enhanced quality of life for people affected by diabetes; and
  - Effective and efficient health services that balance best practice and innovation to foster primary, secondary, and tertiary prevention of diabetes (MOHP & MOHS, 2002).

Diabetes Self-Management Program

The main goal of the Diabetes Self-Management Program (DSMP) is to give people the motivation, confidence, and skills to maintain behaviour changes important to managing diabetes. The DSMP project team includes the University of Victoria Centre on Aging, and the Canadian Diabetes Association, Pacific Area. The project coordinator recruits and trains people with diabetes to become volunteer program leaders. These program leaders then deliver a six-week interactive program in community locations such as libraries, seniors centres, and community centres.

In just over 2 years, the program has trained 226 program leaders in 23 communities, who have in turn delivered the program to 731 participants.

The evaluation of this program has had many positive results. At six months post-program, people who had participated in the DSMP had improved communication with their doctor; were better able to manage disease symptoms themselves; believed they had better health; were less distressed by their symptoms; were experiencing less pain; were eating better; and had fewer days where they missed taking medications as prescribed. More information on this program can be obtained from the Chronic Disease Self-Management Program website or by contacting 1-866-902-3767 (Health Canada, 2004) (www.coag.uvic.ca/cdsmp).



Chapter 6 Recommendations

In 2003/2004, approximately 220,000 people were living with diabetes in British Columbia. In addition, more than 20,000 individuals are newly diagnosed with diabetes every year. As mentioned in previous chapters, diabetes is both a preventable and manageable disease. Research has consistently shown that Type 2 diabetes is associated with obesity and physical inactivity, and lifestyle modification involving weight management and physical activity results in a lower risk of developing diabetes.

On Prevention of Diabetes

As reported in Chapter 4 of this report, based on Canadian Community Health Survey (CCHS) data, of all those who have identified themselves as being diabetic, 69 per cent were overweight or obese and 41 per cent were physically inactive in 2003. The prevention of Type 2 diabetes then must entail a multi-faceted public health approach that will result in long-term weight management and physical activity. This approach needs to involve governments at all levels, food and agricultural industries, professional associations, labour unions, consumer groups, business leaders, school boards, and community groups who will all engage in an effort to reduce obesity and overweight in the population (Ontario Chief Medical Officer of Health, 1999).

Improvement in the prevention of diabetes requires action in the following areas:

- Importance of data and research
- School health
- Food security
- Public education and community interventions
- Monitoring and regulation of marketing approaches of the food industry
- Urban design and transportation
- Prevention of diabetes in the Aboriginal population
- Commitment to actions and goals

Importance of Data and Research

Effective policy decisions generally depend on reliable and good quality population-level data. For prevention programs to be successful, a review of existing data sources is required and data gaps need to be identified. Recent partnerships between federal, provincial, and territorial governments and other organizations resulted in the National Diabetes Surveillance System (NDSS); this has made a significant improvement in the availability of prevalence, incidence, and projection data for diabetes. In addition, a recent partnership between Health Canada and Statistics Canada to conduct the nutrition component of the CCHS has resulted in more accurate data and information on food and nutrient intakes.

Research is an important tool for making policy decisions. Evaluating the effectiveness of the programs and policies is a key research objective to support future policy development. In order to make effective policy decisions, more quality data and research on prevention of diabetes are needed (Canadian Institute for Health Information, 2004).

"Health is directly linked to educational achievement, quality of life and economic productivity. Research in both developing and developed countries demonstrates that school health programs can simultaneously reduce common health problems, increase the efficiency of the education system and advance public health, education and social and economic development in each nation" (WHO, 1998).

School Health

Another area for prevention is focusing on in-school and after-school programs where a safe and active environment could be provided for the promotion of healthy eating and physical activity among children and youth. On average, children spend six hours a day, five days a week in schools. The years from Kindergarten to Grade 12 create a perfect opportunity to target effective health promotion strategies and provide opportunities for physical exercise and sports. An added bonus is that children often become message carriers for the entire family, carrying home information about the need for healthy diets, smoking cessation, and physical activity that helps influence change in their family.

In addition, the school environment is an ideal setting for providing comprehensive health promotion activities that will enhance physical, social, emotional, and intellectual development. Furthermore, the knowledge, attitude, and behaviours established in childhood and youth have a direct impact on the lives of individuals in later years. Healthy children will more than likely create healthy adults.

BC School Initiatives on Promoting Healthy Eating and Increasing Physical Activity

ActNow BC

A coordinated approach to prevention and health promotion involving reducing tobacco use, increasing physical activity, reducing obesity, and increasing healthy eating.

Action Schools! BC

A unique program that incorporates physical activity throughout the school day.

Rails to Trails

A program involving conversion of abandoned rail grades to recreation corridors; this program has helped to improve health and enhance communities as well as benefiting the economy in British Columbia. Examples of this project include the Kettle Valley Railway Trail in Hope and the Galloping Goose Trail in Victoria.

Creative Use of School Space

Use of under-utilized spaces in schools and communities for activities such as physical activities, youth drop-in centres and other programs to promote wellness in the communities.

School Healthy Food Program

An initiative in conjunction with the Ministry of Education to eliminate junk foods like chocolate bars, chips, and sugary drinks from vending machines in all public schools in BC and replace them with healthy foods such as milk, yogurt, cheese, pretzels, and popcorn.

BC Agriculture in the Classroom

A pilot project in Kelowna by the Ministry of Agriculture and Lands to provide a piece of fruit to children in local schools on a daily basis.

For details on these and other school health promotion programs, please consult the Ministry of Health website at www.healthservices.gov.bc.ca/

Food Security

Past studies have documented the strong association between food-insecure households and significantly worse dietary intake. Individuals in food-insecure households are more likely to have heart disease, diabetes, and high blood pressure; their food intake would not likely provide them with the ability to manage the dietary aspects of their conditions (Dietitians of Canada, 2005). Ensuring that social assistance and low income supports are tied to the cost of a healthy food basket could help to reverse the association between low income, food insecurity, and chronic diseases.

Public Education and Community Interventions

Public education is essential in developing comprehensive prevention strategies. Public education and health promotion regarding diet and physical activity are major tools in helping people to overcome obesity and prevent diabetes. Programs such as Healthy Eating and Active Living in the North are essential in providing support for this initiative. It is important to note that public education programs need to be diversified for those with and without diabetes and should also target special needs groups such as aboriginal populations. Diabetes patients need to be treated individually and strategies such as different approaches to diet, physical activity, and medication should be tailored to individual needs. Health care providers should also receive ongoing training to educate, direct, and support behavioural changes in patients.

Monitoring and Regulation of Marketing Approaches of the Food Industry

Monitoring and regulating marketing approaches adopted by the food industry could be an important strategy in preventing obesity and diabetes. Marketing foods high in fat, sugar, or starch such as soft drinks, candy, and potato chips, especially to children, is quite possibly contributing to the rising rates of obesity.

Healthy Official Plans

Recently, Canadian municipalities are adopting the health of the community as a goal for their official plans. For instance, in the early 1990s, the 21 municipalities of the Greater Vancouver region developed a Livable Region Strategic Plan (LRSP) as their official growth strategy. The LRSP provides a framework for making regional land use and transportation decisions in partnership with member municipalities, the provincial government and other agencies. So far, the protected green zone has increased by approximately 60,000 hectares. To determine if the plan is promoting active commuting patterns, the LRSP is monitoring a variety of indicators related to physical activity, including number of vehicles per household and the proportion of children walking or bicycling to school. (Canadian Institute for Health Information, 2004)

Regulating nutrition information provided by food manufacturers to people could be one measure of helping people make better informed food choices. Recently Health Canada has introduced regulations that require mandatory labelling of nutritional information in most pre-packaged foods sold in Canada. These new regulations require manufacturers to provide nutritional information in a consistent way on their food products and the regulations also permit—for the first time in Canada—diet-related health claims for food (Canadian Institute for Health Information, 2004).

Urban Design and Transportation

While research has not yet proven a causal link between the effect of urban design and physical activity and obesity, it is apparent that certain urban planning and design features promote physical activity. Recreation facilities, trails, and safe bike lanes will encourage people to be active, while decentralized, low-density residential

development, and growth of highways and freeways will discourage it. Community planning and design is an important potential feature of policy that will promote physical activity and reduce obesity, and reduce the risk of developing diabetes (Ontario Chief Medical Officer of Health, 1999).

Prevention of Diabetes in the First Nations Population

In British Columbia, the First Nations population has higher incidence and prevalence rates of diabetes compared to the rest of the BC population. Traditionally, the First Nations population had access to their own nutritious foods and were much more active. A combination of a change from their traditional diet to one high in fat and sugar, and a change to a sedentary lifestyle, may be responsible for the increase in the rate of diabetes among First Nations. The following changes are recommended to prevent obesity and the development of diabetes:

- Aboriginal communities (First Nations, Métis and Inuit) should be supported in ensuring that healthy and affordable foods are available.
- Possibilities of local food production should also be considered.
- Communities interested in a re-introduction of traditional diets or their equivalent should be supported.
- Educational programs on diabetes should be more accessible and cultural and language differences should be considered.
- Community programs for prevention and management of diabetes should be available and accessible to the Aboriginal population (First Nations, Métis and Inuit) in the province.
- Neighbourhoods should be safe for families and children to be physically active.

In addition, we would like to reiterate the following recommendations from the 2001 PHO Report, *The Health and Well-being of Aboriginal People in British Columbia:*

Improved standard of living

- Work collaboratively to improve housing conditions and economic and educational opportunities for Aboriginal people.

More recognition and respect

- Increase awareness of the health status of Aboriginal people and the health issues and challenges that Aboriginal people face.

More holistic approach

- Pay more attention to the non-medical, cultural, and spiritual determinants of health.
- Encourage participatory research to gain a clearer understanding as to why some Aboriginal communities are "healthier" than others.

More autonomy

- Support efforts by Aboriginal people to achieve self-determination and a collective sense of control over their futures, in both on-and off-reserve communities.

More representation

- Encourage greater Aboriginal participation in health governance and in the design and delivery of culturally-appropriate health services.

Commitment to Actions and Goals

It is important to note that for prevention strategies to be successful, a concentrated, coordinated effort that is supported with committed resources and funding over a number of years is necessary. The success of the tobacco reduction strategy has demonstrated that such an approach will achieve the desired outcomes.

On Management of Diabetes

Management of diabetes requires preventing and managing the development of complications associated with Type 2 diabetes. Once an individual is diagnosed with diabetes, the treatment should focus on reducing

blood glucose levels towards the normal range to reduce the risk of microvascular complications such as kidney disease, eye disease, and amputation. Like prevention, the management of diabetes requires a multi-faceted approach involving medical and health care professionals, patients, and community programs, as well as access to resources and services.

Improvement in the management of diabetes requires actions in the following areas:

- Reliable and Efficient Patient Registry and Recall System
- Provision of recommended services
- Education and Diabetes Self-Management Program
- Reliable and efficient primary care system

Reliable and Efficient Patient Registry and Recall System

A computerized system of patient registers is necessary so that doctors can track and recall patients for tests and treatments. The Ministry of Health has developed a registry of people with diabetes through a review of Medical Services Plan, PharmaCare, Pharmanet, and hospital records for evidence of health care services relating to diabetes. The data collected are intended to be used by physicians who can access information (through a secure web connection) to see how many of their patients have diabetes, what are their particulars, and how they manage their diabetes compared to provincial standards. The Patient Registry and Recall System needs to be expanded to provide a recall and reminder service so that physicians can note which patients are not coming for regular visits and remind them to do so.

Provision of Recommended Services

Medical studies have proven that many complications of diabetes can be delayed or prevented with good management practices and clinical care. Good management practices include control of glycemia, lipids, and blood pressure; and early detection and treatment of eye problems, damages to the kidney, and foot disorders.

South Island Chronic Disease Management Project

A Victoria initiative, the South Island Chronic Disease Management Project, launched in 2003, recently won the 3M Health Care Quality Team Award. This project features 32 family doctors who work together with a specialized information system to ensure their patients with diabetes, depression and congestive heart failure get proactive care. The system alerts the doctors as to when certain patients need to be recalled for specific tests and laboratory results. Under this project, the doctors still bill Medical Services Plan for their fees; however, they are also reimbursed for the time to develop patient registries and recall systems, to work with other members of the team, to attend meetings of the collaborative, and to collect research data to contribute to the project's evaluation (Select Standing Committee on Health, 2004).

The *Diabetes Care Guide* suggests that most diabetic patients should receive certain recommended services on a regular basis. Although the long-term target for these recommended services is set at 90 per cent, at this point with the exception of lipid tests, less than 50 per cent of patients receive these recommended services on a regular basis.

Education and Diabetes Self-Management Program

The Diabetes Self-Management Program (DSMP) is designed to give patients the motivation, confidence, and skills to maintain behaviour changes important to managing diabetes.

The evaluation of this program has had many positive results. At six months post-program, people who had participated in the DSMP had improved communication with their doctor; were better able to manage disease

symptoms themselves; believed they had better health; were less distressed by their symptoms; were experiencing less pain; were eating better; and had fewer days where they missed taking medications as prescribed. More information on this program can be obtained from Chronic Disease Self-Management Program website www.coag.uvic.ca/cdsmp or by contacting 1-866-902-3767 (Health Canada, 2004).

Reliable and Efficient Primary Health Care

Primary care takes place at the first point of contact with the health system—often in doctors' offices, health clinics or community health centres. Today, it is clear that primary care needs to be organized in a health care team setting, supported by an efficient patient registry system that has a goal of improvement of health through prevention programs as well as care programs.

Surrey, British Columbia: The Winner of the Award to Active Cities

The Centres for Disease Control and Prevention (CDC) of the United States and the Pan American Health Organization (PAHO) cosponsored the first "award to active cities' contest which was part of World Health Day 2002 "Move for Health" Celebration. The contest was limited to the cities in the region of Americas with no more than 1,000,000 population. The applicants were considered from two regional categories—Latin America and Canada and the United States—and were evaluated based on their innovative approaches in fostering safe environments and improving public spaces including parks, bike trails and walking paths for people to engage in active lifestyles. Seven cities from Canada and the United States entered the competition. The city of Surrey, British Columbia was the winner of the award based on providing diverse programs and activities to promote physical activity. (Neiman, A. & Jacoby, E., 2003)

The health care team could involve doctors, nurses, dietitians, physiotherapists, pharmacists, social workers, counsellors and other health care professionals. This team of health care professionals would integrate prevention programs such as interventions in smoking reduction, physical activity, and weight management into the care component, particularly for those who are at risk of developing chronic diseases such as diabetes. The system will also continue to care for those who are diagnosed with a chronic disease to prevent or delay further complications (Millar, 2005).

What needs to be done?

What can individuals do?

- **Reduce overweight and obesity** – Individuals can prevent or reduce obesity by increasing physical activity, maintaining a healthy weight, and eating a healthy and balanced diet.
- **Increase physical activity** – Physical activity improves insulin sensitivity and enhances glucose tolerance. Exercise also prevents obesity, which is a major factor for Type 2 diabetes.
- **Eat a healthy and balanced diet** – A diet low in saturated fat and sugar and high in complex carbohydrates and dietary fibre, such as one with fruits, vegetables, and whole grains is strongly recommended for promoting overall health.
- **Learn about diabetes and screening** – Individuals should be aware of the risk factors for diabetes. Early detection and treatment of diabetes can prevent or delay complications associated with the disease. Once individuals develop diabetes, they must monitor their blood glucose level and receive the other recommended services provided for diabetic individuals on a regular basis. For more information on these services please contact the Chronic Disease Management Branch, Ministry of Health, (www.healthservices.gov.bc.ca/cdm/). To learn more about diabetes, please consult Resources for People with Diabetes in Appendix J of this report.

What can communities do?

- Communities must promote physical activity, healthy eating and healthy weights. Schools should encourage physical activity every day and ensure that the cafeteria and vending machines provide healthy food.
- Communities should encourage physical activity and provide affordable recreational facilities. Neighbourhoods need to have access to clean and safe parks and walking paths, safe bicycle lanes and other facilities to encourage residents to engage in outdoor physical activities.
- Communities need to develop programs such as community kitchens and gardens and should encourage local markets to provide better selections of healthy food.

What can physicians and health care professionals do?

- Health care providers should identify people at high risk of developing diabetes. Obesity and physical activity should be addressed and treated accordingly
- Once patients are diagnosed with diabetes, proper care should be taken so that further complications are prevented or delayed.
- Recommended services and tests for diabetes patients such as control of glycemia, lipids, and blood pressure; and early detection and treatment of eye problems, damage to the kidneys and foot disorders should be provided to all patients on a regular basis.
- Physicians should educate their patients to prevent and reduce the risk of diabetes. Strategies should involve and empower clients to participate in behaviour modification and management of their disease.
- A successful diabetes strategy will depend on a coordinated approach by doctors, dietitians, educators and specialists and should also involve persons with diabetes and their family members.

What can governments do?

- Governments need to develop an effective system to monitor the health impact of diabetes on the population, to study risk factors in the population, to track treatment and follow-up procedures, to monitor the incidence of diabetes-related complications and to evaluate programs that have been implemented.
- Primary care needs to be redesigned to include a team of health care professionals that would not only care for patients who have been diagnosed with diabetes, but would also integrate prevention strategies into the health care system and guide patients to prevent the development of diabetes in the first place.
- More diabetes education programs are needed to increase awareness about diabetes and its risk factors. Educational programs on how to treat and manage diabetes, such as the patient self-management program, should be available to all patients to avoid further complications.
- Governments should ensure that social assistance and low-income supports are tied to the cost of a healthy food basket in order to reverse the association between low-income, food security, and chronic diseases.
- Marketing approaches adopted by the food industry should be monitored and regulated. Marketing foods high in fat, sugar, or starch is quite possibly contributing to the rising rates of obesity.
- Many diabetics with limited means complain that the costs of glucose-monitoring acts as a disincentive to adequate self-care. The Ministry of Health should review the option of extending PharmaCare coverage for glucose-monitoring devices and other equipment.
- Policy makers should be aware of the current incidence and prevalence, and the projected economic impact of diabetes to be able to implement effective policies and recommendations for the prevention of diabetes.

- More funding for research in diabetes-related fields should be provided. Diabetes research should include the causes as well as reducing the burden of the disease and its complications. More research and support is still needed for community-based prevention strategies, improvements in quality of life and clinical management of those who have been diagnosed, and reduction of the economic and social costs of diabetes.
- More resources should be provided for population-based programs such as ActNow BC to ensure that they are effective and sustained long enough to make a difference in the prevention of chronic diseases such as diabetes.

Appendix A
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Appendix C
Data Sources and Definitions

Physician Claims File

Physicians' services performed in hospitals, offices or clinics are captured in the Physician Claims File. In BC, each physician claim contains only one diagnosis, coded using International Classification of Diseases Version 9 (ICD-9). This may result in systematic under-reporting, but generates comparable data for describing trends.

The Physician Claims File is central to the diabetes case-ascertainment algorithm and to algorithms for health services use. Information in the claims file about payments for services may also be useful, as algorithms are developed to refine estimates of the economic burden of diabetes.

A limitation of the claims file is that physicians not paid on a fee-for-service basis are not always required to submit medical claims. Other payment schemes include salary, contract, capitation, and partial fee-for-service. Alternative payment of physicians is more frequent for some specialties in remote areas, and for some primary health care centres. However, in some jurisdictions physicians under alternative payment schemes are still expected to remit service information, otherwise known as 'shadow billing'.

Hospital File

Information about each hospital visit or stay is collected at discharge using an abstracting form. Diagnoses are coded using ICD-9 or ICD-9-Canadian Modification (CM). The use of ICD-10 coding began in BC in 2001/02. All available diagnosis codes (first 16 for ICD-10) are now included in the NDSS case algorithm. Records relating to day surgery are excluded because some provinces do not include these procedures in their hospital files.

Health Insurance Registry

The health insurance registry contains a record for each person entitled to coverage under the provincial/territorial health insurance scheme. NDSS abstracts sex, date of birth (to calculate age), and geographic code from this file (even though this information may also exist in other files). The registry is also used to determine whether persons using hospital or medical services are residents. Hospital or physicians' services records with health insurance numbers not in the registry file for that year are excluded from further processing.

The registry file supplies denominators for rate calculations. Therefore, assessments of the registry's accuracy for this purpose are needed. For example, how closely this file represents the population depends upon it being regularly updated with deaths and migrations. Generally, the date of death, or information allowing its estimation, is recorded in the registry.

PharmaCare File

The BC surveillance model used in this report also incorporates drug payment data, also known as PharmaCare data. PharmaCare data are based on

prescription drug payments for the various sectors of the population that receive government assistance for prescription costs above allowable deductible limits. While there are several PharmaCare plans, the principal plan has been for persons 65 years and older. While PharmaCare data do not provide a complete picture of drug utilization in the population, these data do allow the identification of additional diabetes cases. Work is underway to incorporate PharmaNet data in the analysis, which would provide a more complete picture by including prescription drugs for the entire population, regardless of the drug payment plan of the patient.

Disease surveillance requires a case definition specific to that disease in order to designate an occurrence of the disease in the population. A case definition is the specific set of criteria that must be met to establish a case in the population. The case definition used in this report is a modified version of the one used for the National Diabetes Surveillance System (NDSS) Project.

Diabetes Case Definition

The case definition currently used in NDSS requires that an individual must have either of the following:

- One hospitalization with an ICD-9 code of 250 (diabetes mellitus), selected from all available diagnostic codes on the Hospital Discharge Abstract for years 1995/1996 to 2000/2001, or, equivalent ICD-10 (International Classification of Diseases, Version 10) codes for diabetes for the years 2001/2002 to 2002/2003; or
- Two medical claims with an ICD-9 code of 250 within two years, selected from the first (and only) diagnostic code available on the claim.

The case date is currently defined as the earliest date of the hospitalization or medical claim that contribute to the case definition.

Gestational diabetes cases are not included in the NDSS case definition. In an attempt to exclude gestational diabetes cases that may be miscoded as diabetes (ICD-9 250 or ICD-10 equivalent) from the incidence and prevalence estimates, women with a diabetes diagnosis in the 120 days preceding the first pregnancy-related visit and 90 days after the last pregnancy-related visit were excluded from the case registry. The specific pregnancy-related diagnostic codes excluded were ICD-9 650-669 (see Appendix D for ICD-10 equivalent codes).

Because physician claims do not reliably distinguish between ICD-9 250.0 (Type 2) and 250.1 (Type 1), NDSS is not currently able to assess the level of Type 1 and Type 2 diabetes in the population.

The modified case definition for diabetes surveillance in BC is as follows; or

- an insured individual requires at least one hospital diagnosis of diabetes; or
- two medical diagnoses of diabetes within a period of one year; or
- two PharmaCare prescriptions for insulin or oral hypoglycemics or blood sugar testing strips within one year.

Once a case is identified, it is counted on an ongoing basis until the individual dies or is no longer receiving provincial health insurance coverage. The case definition is subject to ongoing review and will change as warranted by new information or further experience.

Age

Age is calculated as the age as of the end of the fiscal year (March 31). The age groups for national use are 5-year age groups from 20-24 to 80-84, and 85+ for those 85 years of age and older.

While NDSS calculates measures for only the population 20 years and older, this provincial surveillance report includes the under-20 population in order to obtain some indication of the degree to which diabetes affects younger people. While there have been case definition validation studies for ages 20 years and older, such validation has not taken place for the population less than 20 years old. Nevertheless, estimating diabetes in the younger population is important, as most of these young cases

are persons with Type 1 diabetes who must manage their condition very carefully to avoid or delay complications. Type 2 diabetes also occurs in this age group, and there are concerns that the incidence of Type 2 diabetes is on the increase in young people. Further analysis of prescription drug data will provide a more specific method of identifying Type 1 diabetes, based on insulin utilization. For the BC surveillance, 10-year age groups from <1-10 through 30-39, 5-year age groups from 40-44 through 80-84, and 85+ are used for incidence and prevalence calculations.

Incidence

Incidence is the number, or rate, of new cases occurring each year in the population. New cases arise sporadically and create volatility in the rates for small populations, so a 5-year period is used to smooth out the fluctuation in the age-specific rates.

NDSS calculates diabetes incidence as: (total number of people with a diabetes case date in the current fiscal year) ÷ (total population count for the current fiscal year without diabetes minus previously prevalent cases).

The denominator uses the count for the entire year rather than the mid-year estimate. It includes persons who migrate or die during the year, since they are included in the numerator. Age-standardizing adjusts for differences in population age structure over time.

Prevalence

Prevalence is the number, or rate, of cases of diabetes existing within a population during the fiscal year (April 1 – March 31).

NDSS calculates diabetes prevalence as: (total number of people with a diabetes case date prior to and including March 31 of the current fiscal year) ÷ (total population count for the current fiscal year).

The denominator uses the count of persons for the entire year rather than the mid-year estimate. It includes persons who migrate or die during the year, since they are included in the numerator. Age-standardizing adjusts for differences in population age structure over time.

Mortality

The mortality rate refers to the force of diabetes deaths for the total population. This measure can refer either to deaths due to diabetes or to deaths with diabetes. Within NDSS, the mortality rate is calculated separately for people with diabetes and without diabetes. Cause of death is not available; therefore, any mortality analyses are based on all causes of death and not just deaths due to diabetes.

NDSS calculates the mortality rate among persons with diabetes as: (total number of deaths among people with diabetes during the current fiscal year) ÷(total number of people with diabetes during the current fiscal year).

NDSS calculates the mortality rate among persons without diabetes as: (total number of deaths among people without diabetes during the current fiscal year) ÷(total number of people without diabetes during the current fiscal year).

NDSS calculates the mortality rate ratio as: (death rate among persons with diabetes) ÷ (death rate among persons without diabetes).

Age-Standardization

To adjust for differences in population age distributions across provinces and territories and the resulting effect on rates, the rates are age-standardized using the 1991 Canadian Census population estimates as the reference population. The rates are age-standardized and not age- and sex-standardized to allow comparisons to be made between the sex-specific standardized rates. Standardization is done using the direct method and 10-year age groups from <1 to 9 through 30-39 and then 5-year age groups from 40-44 on. NDSS software currently calculates standardized rates and confidence intervals using an inverse gamma distribution (inverse chi-square distribution) when the rate is greater than zero based on the work of Anderson & Rosenburg (1998) and Fay & Feuer (1992).

Co-morbidity

Co-morbidity is the number or rate of various conditions in the population which may co-exist with diabetes. Within NDSS, the co-morbidity rate is calculated separately for persons with diabetes and persons without diabetes.

NDSS calculates the morbidity rate among persons with diabetes as: (total number of cases among persons with diabetes during the current fiscal year) ÷ (total number of persons with diabetes during the current fiscal year).

NDSS calculates the morbidity rate ratio as: (morbidity rate among persons with diabetes) ÷ (morbidity rate among persons without diabetes). Only hospitalization diagnoses are considered in measuring co-morbidities.

Although diagnostic coding in hospitals in BC is done using ICD-10 (International Classification of Diseases, version 10), the ICD-9 equivalent is used in counting instances of co-morbid conditions. Co-morbidity codes used are shown in Appendix D.

Status Indian

A Status Indian marker was applied to each individual by linking the Registration and Premium Billing (RPB) information for health-insured persons in BC with BC Vital Statistics Agency information on First Nations status using the probabilistic matching software Automatch. One major source of data was the BC Vital Statistics Agency's statistical database of information extracted from the registration of births and deaths; it includes demographic information, medical information related to the birth or cause of death, and whether the individual was a Status Indian. Another database used to identify Status Indians in the Province was the Indian Status Verification File (SVF)[1] of the First Nations and Inuit Health Branch, Health Canada, originating from the Department of Indian Affairs and Northern Development. It should be emphasized that this database of Status Indians resident in BC includes Status Indians born and registered in other provinces. A third database that was used to identify Status Indians in the province was the Status Indian Entitlement files from the BC Medical Services Plan (MSP). Probabilistic record-matching links records between two data sets through the calculation of linkage likelihood or probability weights, adjusting for incomplete and missing data. Likelihood/probability weights are estimated given all observed agreements and disagreements on all data elements of the records. The probabilistic linkage incorporates variable levels of discriminatory power and reliability by basing the weights on the specific values of the variables. See Appendix E for more details on the matching process.

Time Period

The time period of data available for identifying cases of diabetes is 1992/1993 through 2003/2004, with 1992/1993 being the first year for which the data appear to be of sufficient quality in the MSP administrative database.

The time horizon is an issue for surveillance, given that the case definition must identify both existing (prevalent) cases and new (incident) cases. In the first year, the prevalent cases probably comprise the majority of the cases identified, after which the proportion of initially identified prevalent cases gradually declines and the proportion of true incident cases being identified increases. Over time, all previously unrecognized prevalent cases will gradually either be identified, become deceased, or move away. Those unrecognized prevalent cases of diabetes that remain in the population (assuming they are physician-diagnosed), will probably be eventually identified by the case definition being triggered, either upon being discharged from hospital (since the hospital discharge summary contains a listing of all diagnoses made on a patient), or through PharmaNet activity. This issue has an effect on the accuracy of current prevalence estimates, as well as future diabetes prevalence projections.

[1] *This data source was only approved for use for the period prior to 2003.*

Costing of Diabetes-Related Health Services

The cost calculation of all persons in BC with diabetes focuses on the three major components of the BC Ministry of Health (MOH): Hospitals, Medical Services Plan, and PharmaCare. The cost calculation provides the number of diabetic patients, basic utilization, and total government costs in each of these three components. All figures are calculated and reported on a fiscal year basis (April 1 to March 31).

Diabetic patients' costs are accrued starting in the fiscal year in which they meet the diabetic case definition. It is further assumed that once they meet the diabetic definition they will always be diabetic, and thus are included in the cost calculation in all future years (until death).

Hospital costs are calculated using the MOH hospital separations file. Costs are attributed to the fiscal year in which the separation date occurs. Resource Intensity Weight grouped to 2003 (CRIW03) is totalled, and multiplied by $5,000 to estimate the cost of hospitalization.

MSP costs are calculated by totalling the service unit paid amount and the northern isolation allowance amount for all medical claims paid for by MSP. Paramedical claims and claims paid for by Worker's Compensation Board, Insurance Corporation of British Columbia, the midwife budget, or other provinces are not included. Costs are attributed to the fiscal year in which the service date occurs.

PharmaCare costs are calculated using the ingredient cost paid and professional fee paid fields in the PharmaCare database. Patient/third party insurer co-pays are not included. Federally insured patients' (Status Indians, RCMP, Veterans, etc.) costs are also excluded from the analysis. The costs also do not include special service fees, methadone interaction fees, or long-term care per diem fees. Claims under the palliative care benefit plan are included. Costs are attributed to the fiscal year in which the date of service occurs.

Specific Cause of Death Analysis

The NDSS-identified population register was provided to BC Vital Statistics Agency along with an indicator of diabetes status as determined by the modified NDSS algorithm described. Specific cause of death information was linked to the registry using a deterministic matching process based on Personal Health Number. A summary table by cause of death, age group, and gender was returned. All cause of death coding was done using ICD-10. Calculation of age-standardized rates and rate ratios was performed using the general NDSS process (as described earlier in this appendix).

Projection of Diabetes Prevalence

Projection of diabetes prevalence for the period from 2004/2005 through 2015/2016 were created following the methods of Blanchard (1999). Population projections from P.E.O.P.L.E. 29 (Population Extropolation for Organization Planning With Less Error, run cycle 29) were used as the base population model. Prevalent diabetes cases in 2002/2003 were used as the starting point and for each subsequent year estimated incident cases were added and estimated deaths among existing diabetic cases were removed. The 5-year aggregate incidence and mortality rates for the period 1998/1999 through 2002/2003 were applied to the previous year's population estimate and diabetic cases respectively. No adjustment was made for migration, nor for loss to follow-up.

Appendix D
International Classification of Diseases (ICD) Codes

Gestational Exclusion ICD-10 Codes

The following ICD-10 codes are equivalent to the ICD-9 codes used for exclusion of Gestational Diabetes cases.

O265

O290-O296, O298-O299

O301-O302, O308-O309

O318

O320-O326, O328-O329

O330-O339

O340-O349

O350-O359

O360-0369

O40

O410-O411, O418-O419

O420-O422, O429

O430-O431, O438-O439

O60

O610-O611, O618-O619

O620-O624, O628-O629

O630-O632, O639

O640-O645, O648-O649

O650-O655, O658-O659

O660-O665, O668-O669

O680-O683, O688-O689

O690-O695, O698-O699

O700-O703, O709

O710-O719

O720-O723

O730-O731

O740-O749

O750-O759

O800-O801, O808-O809

O810-O815

O820-O822, O828-O829

O830-O834, O838-O839

O840-O842, O848-O849

O890-O896, O898-O899

O904,O908

O95-O97

Z354-Z356

Co-Morbidity ICD codes

Definitions of Co-morbidities

Cardiovascular Disease:
ICD-9: 390-448
ICD-10: I00-I78

Ischaemic Heart Disease:
ICD-9: 410-414
ICD-10: I20-I25

Hypertensive Disease:
ICD-9: 401-405
ICD-10: I10-I13, I15

Acute Myocardial Infarction:
ICD-9: 410
ICD-10: I21-I22

Heart Failure:
ICD-9: 428
ICD-10: I50

Stroke:
ICD-9: 430-438
ICD-10: I60-I69

Chronic Renal Disease:
ICD-9: 585-586
ICD-10: N18-N19

Lower Limb Amputations:
ICD-9-CM: 8411-8419
ICD-10-CM:

Minor

96.11 Amputation and disarticulation of toes: partial or complete toe amputation

96.12 Amputation and disarticulation of foot: amputation below ankle, transmetatarsal amputation

Major

96.13 Amputation and disarticulation of ankle: amputation of ankle through malleoli of tibia and fibula

96.14 Amputation of lower leg

96.15 Amputation of thigh

Exclusion ICD-9 Codes:

170	Malignant bone tumor
171	Malignant connective tissue tumor
213	Benign neoplasm of bone
740-759	Congenital abnormalities
800-900	Trauma
901-904	Arterial injury
940-950	Burns

Appendix E
Methods and Calculations

Probabilistic Matching using Automatch

Automatch (Matchware Technologies, Inc., Silver Spring, MD) was used for the record linkage using an algorithm (Jaro, 1995). The Status Indian linkage was done as part of a larger BC resident deaths linkage project. The process involves a sequence of user-defined linkage runs; records remaining unlinked from run 1 were available for linkage in run 2, and so on. For each run, the user first defines blocking variables, which must match exactly in the two files. Automatch sorts each input file by the blocking variables, and then compares records within each block, based upon values of the other (matching) variables, which need not match exactly.

Theoretical Description of Linking using Automatch

Probabilistic record matching links records between two data sets through the calculation of linkage likelihood or probability weights, adjusting for incomplete and missing data. Likelihood/probability weights are estimated given all observed agreements and disagreements on all data elements of the records. The probabilistic linkage incorporates variable levels of discriminatory power and reliability by basing the weights on the specific values of the variables.

Automatch links records of two files using probabilistic record linkage techniques. The computer program assigns a positive weight if the variables on each file agree and negative if the variables disagree. The positive weight is larger if the discriminatory power of the variable is great. For example, a match on personal health number just about guarantees the records in the two separate files are for the same person while a match on sex does not offer the same degree of certainty. In fact, Automatch bases the discriminatory power on the specific values of the variables. For example, the last name Ruehlen would have a greater weight than the last name Smith.

These variable weights are then summed to calculate an aggregate weight for the record pair. The aggregate weight represents the probability that the record pair is a true match. The aggregate weight is compared against two thresholds to classify each case as a match (above the upper cut off), nonmatch (below the lower cut off) or possible match (between the upper and lower cut off).

At the heart of probabilistic record linkage are frequency ratios, determined by the M and U probabilities and the following mathematical formulae:

1) M(i) = reliability – where i is a linkage element

a. probability that linkage element agrees on true matched pair

b. approximately equal to one minus the error rate

c. analogous to sensitivity

2) U(i) = discriminatory power

a. probability that linkage element agrees on true non-matched pair

b. approximately equal to 1 divided by the number values for the variable

c. analogous to specificity

3) M(i) / U(i) - frequency ratio for agreement match on matches

4) 1 – M(i) / 1 – U(i) - frequency ratio for disagreement on matches

5) [ln(M/U) / ln(2)] – agreement weight

6) [ln(1-M / 1 - U) / ln(2)] – disagreement weight

For example, the day of birth may have a value 9. The m probability is the probability among the true linked records that when day of birth is 9 for one of the records, the day of birth is also 9 for the other file record. This could be estimated to be .95. The U probability is similar to the M probability except it applies to the true non-linked records. Without knowing what are the actual true linked and true non-linked records, the user must initially specify the M probabilities on the basis of the best guess. After a preliminary pass, value-specific M probabilities for each variable can be estimated by simply calculating the observed proportion of accepted links that agree on a particular value for particular matching variable. Automatch creates this estimate.

The U probability cannot be measured directly but can be estimated by the frequency of each specific value of each matching variable in the two files. For example, the day of birth is likely to have a frequency of about 0.033 (one in thirty). So the U probability is the likelihood of a match purely by chance.

The following table shows the calculation of agreement and disagreement weights for day of birth:

Comparison Outcome	Proportion True links	Proportion True Non-links	Frequency Ratio	Weight
Agreement	0.95 (m)	0.03 (u)	32 / 1 (m / u)	4.98 [ln(m/u) / ln(2)]
Disagreement	0.05 (1-m)	0.97 (1-u)	1 / 19 (1-m) / (1-u)	-4.28 ln(1-m / 1 - u) / ln(2)

In order to run more efficiently, Automatch uses blocking in conjunction with a series of passes. Blocking involves partitioning the records in both files by common variable(s) and then only conducting comparisons within these blocks of records with the common variable. Automatch brings records together through a series of passes where different blocking variables and thresholds are used. Throughout the match process, the master list frame file is treated as a reference file. All list frame records are included in each pass. However, once a new source record is linked to a master list frame record, it is excluded from all subsequent passes.

The final determination of matches is based on:

1) Match occurring when the total record pair linkage weight is greater than the higher threshold value.
2) Nonmatch occurring when the total record pair linkage weight is less than threshold lower threshold value.
3) Uncertain linkage occurring when the total record pair to its weight is between the two.

Practical Description of Vital Statistics Linkage Project

The Vital Statistics linkage project used a Vital Statistics death file (1980-2002) as the master list frame. This file contained 560,311 cases. The source file was created from Client Registry and Registration and Premium Billing information. It contained the most current demographic information regarding any person who ever had a BC personal health number. This file contained 5,233,029 records.

Vital Statistics Agency performed two rounds of eight passes through the data. Each pass used different blocking variables. A specific set of these variables was processed in a single pass through the data. In the first pass of round 1, for example, last name, first name, second name, birth year, birth month, birthday, and sex were used. A total of 198,981 records met this criterion of having sufficiently similar information in all these fields.

The cutoffs were chosen by Vital Statistics based on past experience.

The rounds/passes, blocking variables, and cutoffs are identified in the following table.

Matching all Cases to Deaths, 1980-2002

ROUND	Pass #	SNDX	LAST	SUR 1	FIRST	INIT 1	SECOND	INIT 2	INIT 1/2	INIT 2/1	BYR	BMO	BDA	SEX	PC1	PC2	PHN	#-matches	Cutoff-Wts
	1		x		x		x				x	x	x	x				198,981	10.0/ 10.0
	2										x			x			x	60,101	10.0/ 5.0
	3		x		x							x	x	x	x			19,980	40.5/ 35.5
	4				x		x				x	x	x					1,682	22.0/ 15.0
# 1	5		x						x		x	x	x	x				1,841	35.0/ 32.0
	6		x							x	x	x	x	x				723	35.0/ 32.0
	7		x		x			x			x		x	x				1,529	35.5/ 31.5
	8	x			x			x			x	x		x				2,285	35.0/ 32.0
	Total																	287,122	

ROUND	Pass #	SNDX	LAST	SUR 1	FIRST	INIT 1	SECOND	INIT 2	INIT 1/2	INIT 2/1	BYR	BMO	BDA	SEX	PC1	PC2	PHN	#-matches	Weights
	1		x		x		x				x				x			139	35.0/ 22.0
	2	x			x						x	x	x		x			423	35.0/ 22.0
	3			x	x						x	x	x		x			191	35.0/ 22.0
	4			x		x					x	x		x	x	x		5,803	36.5/ 23.5
# 2	5		x			x		x			x	x		x	x	x		0	41.5/ 21.5
	6	x							x		x	x	x	x	x	x		17	36.5/ 16.5
	7	x								x	x	x	x	x	x	x		10	16.8/ 10.0
	8				x							x	x				x	535	10.0/ 5.0
	Total																	7,118	
																	Total	**294,240**	
																	Residuals w/ death date	**43,171**	
																	Total w/ death date	**337,411**	

Total Number of Input Records: BC Diabetes – 5,233,029 cases
Deaths (1980-2002) – 560,311 cases

Note:
1) Round 2 was processed based on the residuals from Round #1.
2) #-matches (N=294,240) includes cases with review ("CP - 301 cases) but excludes duplicates ("DP - 77 cases).
3) Total residuals (alive) = 4,895,541
4) Cutoff-wts shows high/low cutoff values for Round #1 and for Round #2 (it is suggested to review those "CP" clerical review pairs).

Appendix F
Formulas used for Calculations

Incidence Rates

Currently three options are available to compute rates and the choice depends on the choice of denominator. For incidence rates, NDSS uses the person years disease-free denominator, or PY_{ij}. Each person is counted as 1 person year for each year in registry.

Age-standardized incidence rates per 100 (let c denote 100 in the formulae below) and the associated 1-a percent confidence interval are computed as:

$$IR_{ij} = c\, I_{ij} / PY_{ij}$$

$$var[IR_{ij}] = c^2\, I_{ij} / PY_{ij}^2$$

$$\text{Lower Bound} = var[IR_{ij}] * invgamma(1-a/2, IR_{ij}^2 / var[IR_{ij}]) / IR_{ij}$$

$$\text{Upper Bound} = var[IR_{ij}] * invgamma(1-a/2, IR_{ij}^2 / var[IR_{ij}]+1) / IR_{ij}$$

Age-Standardized Incidence Rates (per 100)

Let Σ_i denote the summation over the range of age groups of interest. Let p_i denote population of the standard population (we use Canada 1991) and define $w_i = p_i / \Sigma_i p_i$, which is the proportion of the standard population implied by the symbol Σ_i then IR represents the age-standardized incidence rate for that age group and is defined below:

$$IR_j = \Sigma_i\, wi\, IR_{ij} = \Sigma_i\, w_i\, c\, I_{ij} / PY_{ij}$$

$$var[IR_j] = \Sigma_i\, w_i 2\, var[IR_{ij}] = \Sigma_i\, w_i^2\, c^2 I_{ij} / PY_{ij}^2$$

$$\text{Lower Bound} = var[IR_j] * invgamma(1-a/2, IR_j^2 / var[IR_j]) / IR_j$$

$$\text{Upper Bound} = var[IR_j] * invgamma(1-a/2, IR_j^2 / var[IR_j]+1) / IR_j$$

Prevalence Rates

Age-specific prevalence rates are computed as:

$$PR_i = P_i / N_i$$

$$\text{var}[PR_i] = P_i / N_i^2$$

$$\text{Lower Bound} = \text{var}[PR_i] * \text{invgamma}(1\text{-}a/2, PR_i^2 / \text{var}[PR_i]) / PR_i$$

$$\text{Upper Bound} = \text{var}[PR_i] * \text{invgamma}(1\text{-}a/2, PR_i^2 / \text{var}[PR_i]+1) / PR_i$$

where invgamma denotes the inverse of the gamma distribution function. This function requires two parameters the first is a probability value in the range (0,1) and the second is the distribution shape parameter, which must be greater than zero. The value returned by this function is the quantile value associated with the probability of interest.

Age-Standardized Prevalence Rates

Let Σ_i denote the summation over the range of age groups of interest. Let p_i denote population of the standard population (we use Canada 1991) and define $w_i = p_i / \Sigma_i p_i$, which is the proportion of the standard population implied by the symbol Σ_i then PR represents the age-standardized prevalence rate for that age group and is defined below:

$$PR = \Sigma_i w_i PR_i = \Sigma_i w_i P_i / N_i$$

$$\text{var}[PR] = \Sigma_i w_i^2 \text{var}[PR_i] = \Sigma_i w_i^2 P_i / N_i^2$$

$$\text{Lower Bound} = \text{var}[PR] * \text{invgamma}(1\text{-}a/2, PR^2 / \text{var}[PR]) / PR$$

$$\text{Upper Bound} = \text{var}[PR] * \text{invgamma}(1\text{-}a/2, PR^2 / \text{var}[PR]+1) / PR$$

Rate Ratios

Rates and their variance estimates output from the rates calculation macro are used to compute rate ratios. For the most part age-standardized rates will be used to compute rate ratios. For completeness, we include both the age-specific and age-standardized rate ratio calculations. For age-specific rates, let R_{i1} represent rates for diabetics, R_{i0} represent rates for non-diabetics and RR_i the rate ratio. Below we give the formulae for calculation of rate ratio and its (1-a) percent confidence bound.

$$RR_i = R_{i1} / R_{i0}$$

$$\text{var}[\log(RR_i)] = \text{var}[R_{i1}]/R_{i1}^2 + \text{var}[R_{i0}]/R_{i0}^2$$

$$\text{Lower Bound} = \exp(\log(RR_i) - \text{probit}(1\text{-}a/2)\, \text{var}[\log(RR_i)]^{1/2})$$

$$\text{Upper Bound} = \exp(\log(RR_i) + \text{probit}(1\text{-}a/2)\, \text{var}[\log(RR_i)]^{1/2})$$

Age-standardized rate ratios are computed in an identical fashion, however the notation is different, notably the index for age is not required.

$$RR = R_1 / R_0$$

$$var[\log(RR)] = var[R_1]/R_1^2 + var[R_{i0}]/R_0^2$$

$$\text{Lower Bound} = \exp(\log(RR) - \text{probit}(1-a/2)\ var[\log(RR)]^{1/2})$$

$$\text{Upper Bound} = \exp(\log(RR) + \text{probit}(1-a/2)\ var[\log(RR)]^{1/2})$$

Projections

The projected number of prevalent cases and the resulting projected prevalence rate were calculated for the period 2004/2005 to 2015/2016.

$$ppij = PRi; \text{ when } j = 2003/2004$$

$$ppij = PPij * ppi(j-1) (1- MRi)+ PPij \quad IRi (1- ppi(j-1))$$

$$ppRij = ppij / PPij$$

Notation:

PRi represents the prevalence rate 2003/2004.

IRi represents the incident rate 1998/1999 to 2002/2003.

MRi represents the mortality rate 1998/1999 to 2002/2003.

PPij represents the projected population.

ppij represents the projected number of prevalent cases.

ppRij represents the projected prevalence rate.

Age-Standardized Mortality Rate (ASMR)

Let Σ_i denote the summation over the range of age groups of interest. Let p_i denote population of the standard population (we use Canada 1991) and define $w_i = p_i / \Sigma_i p_i$, which is the proportion of the standard population implied by the symbol Σ_i then MR represents the age-standardized mortality rate for that age group and is defined below:

$$MR_j = \Sigma_i w_i MR_{ij} = \Sigma_i w_i M_{ij} / PY_{ij}$$

$$var[MR_j] = \Sigma_i w_i^2 var[MR_{ij}] = \Sigma_i w_i^2 M_{ij} / PY_{ij}^2$$

$$\text{Lower Bound} = var[MR_j] * \text{invgamma}(1-a/2, MR_j^2 / var[MR_j]) / MR_j$$

$$\text{Upper Bound} = var[MR_j] * \text{invgamma}(1-a/2, MR_j^2 / var[MR_j]+1) / MR_j$$

Appendix G

Age Structure of Status Indians and Other BC Residents

In British Columbia, the Status Indian population is much younger than the population of other BC residents. The following figure demonstrates these differences by showing the distribution of the populations by 5-year age group and gender of both Status Indians and other BC residents.

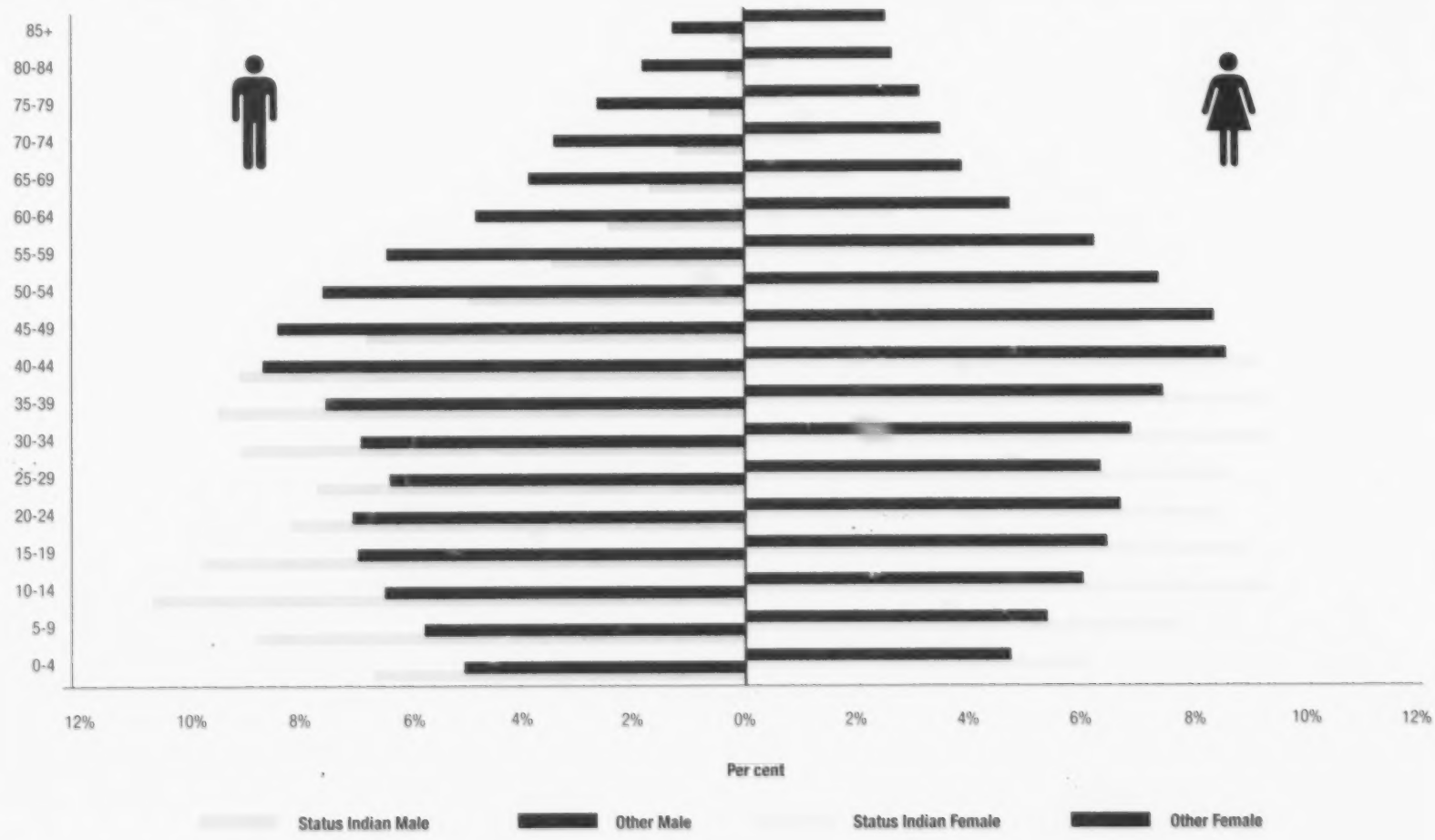
Ages less than 25 years account for 42 per cent of the Status Indian population compared to 30 per cent of other BC residents. In the age group 25-44 years, the proportion is 36 per cent for Status Indians and 29 per cent for other BC residents.

At age 40-44 years, the proportions are relatively similar. For ages 45 years and older, the proportions shift dramatically. In the age group 45-64 years, the proportion of Status Indians is only 18 per cent compared to 27 per cent for other BC residents. In the seniors age group (65+ years), the proportion of Status Indians is less than 5 per cent compared to 14 per cent for other BC residents.

It is important to consider these differences in population structure when comparing rates of disease in the two populations. Age-standardization of disease rates adjusts the rate of illness in the two populations by weighting according to a common age structure for both populations. In other words, the resulting age-standardized rates are those that would occur if both populations had the same age structure.

Figure G1

Percentage Distribution by Age and Sex, Status Indian and other BC Resident Populations, BC, 2003/2004



Source: Population Health Surveillance and Epidemiology, Ministry of Health, 2005

Appendix H

Detailed Cause of Death Table

Table H1

Cause of Death Comparison for Persons With and Without Diabetes, by Diagnostic Chapter and Selected Causes, Other BC Residents, BC, 1992/1993-2003/2004*

Cause of Death	Deaths With Diabetes	% Deaths With Diabetes	% of Cause Persons With Diabetes	Deaths Without Diabetes	% Deaths Without Diabetes	ASMR With Diabetes	ASMR Without Diabetes	Rate Ratio	Confidence Interval Rate Ratio	
									Lower	Upper
Certain infectious and parasitic diseases A00-B99	773	1.4	14.9	4,432	1.7	2.6	1.0	2.7	2.4	3.1
Malignant Neoplasms (cancer) C00-C97	12,397	21.7	14.3	74,040	29.2	32.5	15.8	2.1	2.0	2.1
Malignant Neoplasms of trachea and lung C33-C34	2,899	5.1	12.7	19,874	7.8	7.2	4.3	1.7	1.6	1.8
Malignant Neoplasms of female breast C50.0-C50.9	743	1.3	11.0	6,037	2.4	2.0	1.3	1.5	1.4	1.7
Malignant Neoplasms of colon and rectum C18-C21	1,105	1.9	14.0	6,793	2.7	2.6	1.4	1.8	1.6	2.0
Cervical Cancer C53	59	0.1	11.1	471	0.2	0.2	0.1	2.3	1.7	3.2
Prostate Cancer C61	835	1.5	14.8	4,821	1.9	1.5	1.0	1.4	1.3	1.6
Other malignant neoplasms	6,756	11.8	15.8	36,044	14.2	N/A	N/A	N/A	—	—
Diabetes mellitus E10-E14	7,569	13.2	100.0	—	—	N/A	N/A	N/A	—	—
Mental and behavioural disorders F00-F99	760	1.3	11.3	5,946	2.3	1.7	1.3	1.3	1.2	1.5
Use of Alcohol F10	152	0.3	12.2	1,094	0.4	0.7	0.2	3.0	2.4	3.6
Other mental and behavioural disorders	608	1.1	11.1	4,852	1.9	N/A	N/A	N/A	—	—
Diseases of the nervous system G00-G99	1,094	1.9	10.2	9,668	3.8	2.5	2.1	1.2	1.0	1.5
Diseases of the circulatory system I00-I99	23,168	40.5	20.4	90,136	35.5	46.8	19.1	2.5	2.4	2.5
Acute Myocardial Infarction I21-I22	6,933	12.1	23.1	23,112	9.1	15.2	4.9	3.1	3.0	3.2
Other Ischaemic heart diseases I20, I23-I25	6,159	10.8	22.8	20,854	8.2	12.6	4.4	2.8	2.7	3.0
Cerebrovascular diseases I60-I69	4,676	8.2	18.3	20,931	8.3	8.3	4.4	1.9	1.8	1.9
Hypertensive Disease I10-I13, I15	444	0.8	19.6	1,819	0.7	0.9	0.4	2.4	2.1	2.7
Heart Failure I50	1,618	2.8	20.1	6,434	2.5	2.6	1.4	1.9	1.8	2.0
Diseases of Arteries I70-I78	946	1.7	14.2	5,715	2.3	1.8	1.2	1.5	1.4	1.6
Other diseases of the circulatory system	2,392	4.2	17.5	11,271	4.4	N/A	N/A	N/A	—	—

Table H1
(continued)

Cause of Death	Deaths With Diabetes	% Deaths With Diabetes	% of Cause Persons With Diabetes	Deaths Without Diabetes	% Deaths Without Diabetes	ASMR With Diabetes	ASMR Without Diabetes	Rate Ratio	Confidence Interval Rate Ratio	
									Lower	Upper
Diseases of the respiratory system J00-J99	4,992	8.7	15.2	27,769	11.0	9.0	5.9	1.5	1.5	1.6
Pneumonia/Influenza J10-J18.1, J18.8, J18.9	2,249	3.9	15.7	12,112	4.8	3.8	2.6	1.5	1.4	1.6
Chronic Pulmonary Disease J41-J44	1,872	3.3	14.1	11,364	4.5	3.2	2.4	1.3	1.3	1.4
Other diseases of the respiratory system	871	1.5	16.9	4,293	1.7	N/A	N/A	N/A	—	—
Diseases of the digestive system K00-K93	2,120	3.7	18.3	9,440	3.7	5.5	2.0	2.7	2.6	2.9
Chronic liver disease/cirrhosis K70, K73-K74, K76.0-K76.1	618	1.1	20.8	2,358	0.9	2.2	0.5	4.3	3.9	4.8
Other diseases of the digestive system	1,502	2.6	17.5	7,082	2.8	N/A	N/A	N/A	—	—
Diseases of the genitourinary system N00-N99	1,411	2.5	27.4	3,734	1.5	2.9	0.8	3.6	3.3	3.9
Renal Disease N18-N19	925	1.6	30.5	2,106	0.8	2.0	0.4	4.4	4.0	4.8
Other diseases of the genitourinary system	486	0.8	23.0	1,628	0.6	N/A	N/A	N/A	—	—
External causes of morbidity and mortality V01-Y98	1,407	2.5	7.0	18,835	7.4	5.2	4.2	1.3	1.1	1.4
Accidental Poisoning X40-X49	116	0.2	3.6	3,141	1.2	0.8	0.7	1.2	1.0	1.4
Suicide X60-X84, Y87.0	267	0.5	5.5	4,570	1.8	1.3	1.0	1.3	1.1	1.5
Adverse Affects of Drugs Y40-Y59	26	0.0	17.1	126	0.0	0.1	0.0	2.9	1.7	5.0
Med/Surg misadventure, etc. Y60-Y84	61	0.1	22.3	213	0.1	0.2	0.0	3.3	2.3	4.8
Falls W00-W19	537	0.9	14.0	3,293	1.3	1.0	0.7	1.4	1.2	1.5
Other external causes of morbidity and mortality	400	0.7	5.1	7,492	3.0	N/A	N/A	N/A	—	—
Other Causes	1,491	2.6	13.5	9,554	3.8	N/A	N/A	N/A	—	—
All Causes	57,182	100.0	18.4	25,3554	100	131.8	54.2	2.4	2.4	2.5

*Note: Figures 3.9b and Table H1 present rate ratios based on different data over different time periods and using different age groupings for the underlying age-standardized mortality rates. As such, the rate ratios may not be directly comparable. Figure 3.9b is using probabilistic linkage to overall death counts, age-standardized mortality rates, and rate ratios over a 5-year period (age-standardized using 14 age groups). Table H1 is using deterministic linkage to cause of death counts, age-standardized mortality rates, and rate ratios over a 12-year period (age-standardized using three age groups). Age-standardized mortality rate (ASMR) per 10,000 and rate ratio with 95 per cent confidence interval (CI).

Appendix I
Detailed Regional Prevalence Data

Diabetes Age Standardized Prevalence by HSDA

Figure I.1 shows the age-standardized prevalence rates of diabetes for the BC population by Health Service Delivery Area (HSDA). The age-standardized prevalence rates range from a low of 3.2 per cent in North Shore-Coast Garibaldi to a high of 4.9 per cent in the Northern Interior. Beyond body weight and physical activity, income, education, employment, and ethnicity may also play roles in influencing geographic variation in the prevalence rates of diabetes. In these data, it is not possible to control for these factors individually or in combination to determine the degree to which they might influence rates.

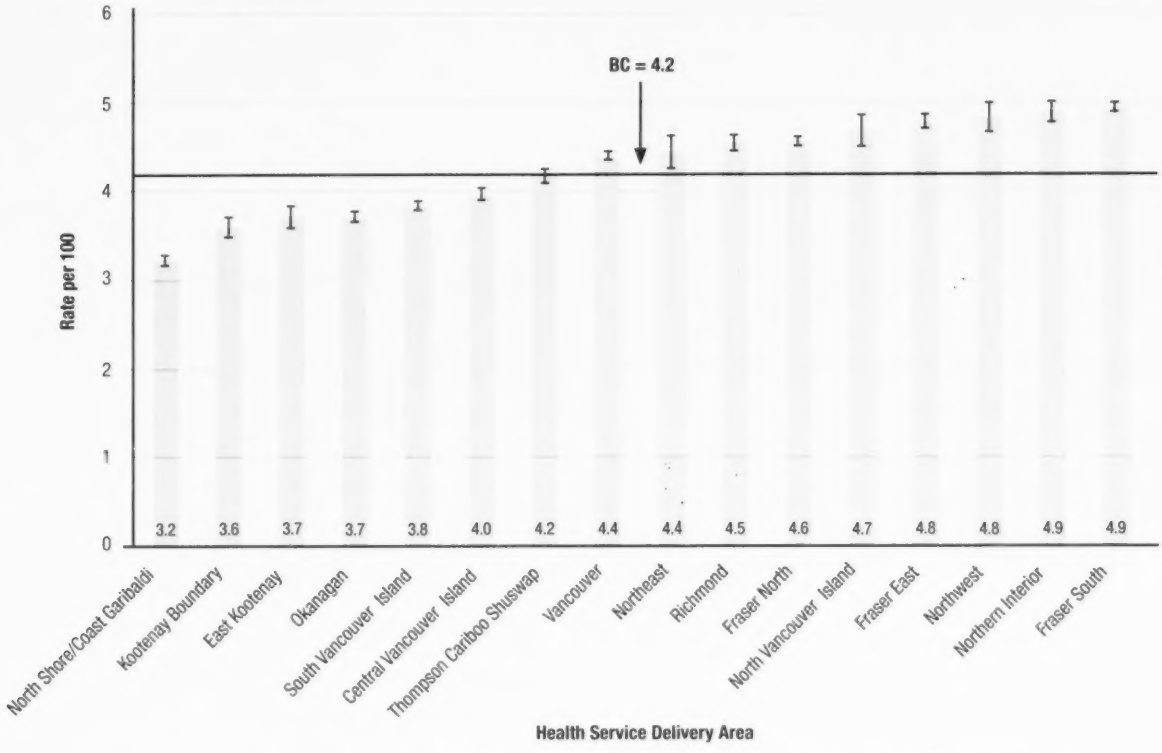
Rates are generally higher in the north and lower in the south although this pattern is not consistent in all cases. Northwest and Northern Interior and Fraser South have the highest rates in the province. However, Northeast has a rate closer to the provincial rate.

Income, education, and employment levels vary among regions in BC and may have an effect on the level of diabetes in the population. North Shore/Coast Garibaldi has one of the highest income, education, and employment levels in the province and the lowest rate of diabetes prevalence. The Okanagan, South Vancouver Island and Central Vancouver Island cluster together significantly below the provincial rate of diabetes. These communities share similar populations in terms of socio-economic status. In contrast, Richmond and Fraser East have relatively high socio-economic status but have diabetes prevalence rates significantly above the provincial rate. Diabetes rates in these areas may be affected more by ethnicity than by other factors.

High rates of diabetes prevalence occur in areas where higher proportions of the population are of Aboriginal, Asian, or South Asian decent. Northwest, Northern Interior, and North Vancouver Island have higher proportions of Status Indians and show significantly higher rates of diabetes. Fraser North and Fraser East have higher concentrations of South Asian (India, Pakistan, Sri Lanka) peoples, where rates are also well above the provincial rate. Richmond and Vancouver have higher proportions of Asian people, and these areas also have a significantly higher prevalence of diabetes.

Socio-economic status and ethnicity may play a part in the relative geographic differences of diabetes prevalence across the province. The interactions between these variables are complex and require further investigation.

Figure I.1 Age-Standardized Prevalence of Diabetes by Health Service Delivery Area, BC, 2003/2004



Source: Population Health Surveillance and Epidemiology, Ministry of Health Services, 2005.

Table I.1

Estimate of Prevalent Cases and Prevalence Rates of Diabetes, BC, 1992/1993 to 2003/2004

Year	Cases	Crude rate per 100	Age-standardized rate per 100	Confidence Interval	
				Lower limit	Upper limit
1992/1993	70,360	2.0	1.8	1.8	1.9
1993/1994	86,058	2.4	2.2	2.2	2.2
1994/1995	99,567	2.6	2.4	2.4	2.5
1995/1996	111,179	2.9	2.7	2.6	2.7
1996/1997	122,371	3.1	2.8	2.8	2.8
1997/1998	135,072	3.4	3.0	3.0	3.1
1998/1999	147,000	3.6	3.2	3.2	3.3
1999/2000	160,277	3.9	3.5	3.4	3.5
2000/2001	174,527	4.3	3.7	3.7	3.7
2001/2002	189,838	4.6	3.9	3.9	3.9
2002/2003	205,163	4.9	4.1	4.1	4.1
2003/2004	216,488	5.1	4.2	4.2	4.2

Note: 2003/2004 numbers are not adjusted for incomplete follow-up of the incident case definition.

Table I.2

Age-Specific Prevalent Cases and Prevalence Rates of Diabetes, BC, 2003/2004 (unadjusted)

	FEMALES				MALES				TOTAL			
		Rate	Confidence Interval			Rate	Confidence Interval			Rate	Confidence Interval	
Age	Cases	per 100	Lower	Upper	Cases	per 100	Lower	Upper	Cases	per 100	Lower	Upper
<10	307	0.1	0.1	0.2	365	0.2	0.1	0.2	672	0.2	0.1	0.2
10-19	1,011	0.4	0.4	0.4	1,114	0.4	0.4	0.4	2,125	0.4	0.4	0.4
20-29	2,080	0.7	0.7	0.8	1,710	0.6	0.6	0.6	3,790	0.7	0.7	0.7
30-39	5,306	1.7	1.7	1.8	4,534	1.5	1.5	1.5	9,840	1.6	1.6	1.6
40-44	4,802	2.6	2.6	2.7	4,975	2.8	2.7	2.8	9,777	2.7	2.6	2.7
45-49	6,574	3.7	3.6	3.8	7,750	4.5	4.4	4.6	14,324	4.1	4.0	4.2
50-54	8,635	5.6	5.5	5.7	11,344	7.3	7.2	7.4	19,980	6.4	6.3	6.5
55-59	10,892	8.3	8.2	8.5	14,216	10.8	10.6	11.0	25,113	9.6	9.4	9.7
60-64	10,976	11.1	10.9	11.3	14,746	14.9	14.6	15.1	25,729	13.0	12.8	13.2
65-69	11,577	14.4	14.1	14.6	14,834	18.7	18.4	19.0	26,426	16.5	16.3	16.7
70-74	12,254	16.8	16.6	17.2	14,852	21.3	20.9	21.6	27,132	19.0	18.8	19.2
75-79	11,362	17.6	17.3	17.9	11,748	22.0	21.6	22.4	23,130	19.6	19.3	19.8
80-84	9,058	16.7	16.4	17.1	7,701	20.8	20.4	21.3	16,769	18.4	18.1	18.7
85 +	7,092	13.7	13.3	14.0	4,570	17.6	17.1	18.1	11,681	14.9	14.6	15.2
Total	101,926	3.9	3.8	3.8	114,459	4.7	4.7	4.6	216,488	4.2	4.2	4.2

Note: 2003/2004 numbers are not adjusted for incomplete follow-up of the incident case definition. Rates for Age Total are age-standardized.

Table I.3

Estimate of Prevalent Cases and Prevalence Rates of Diabetes, by Health Authority, BC, 2003/2004 (unadjusted)

Health Authorities	FEMALES					MALE					TOTAL				
	Prevalent Cases	Crude Rate	Age-Standardized Rate	Confidence Interval Lower	Confidence Interval Upper	Prevalent Cases	Crude Rate	Age-Standardized Rate	Confidence Interval Lower	Confidence Interval Upper	Prevalent Cases	Crude Rate	Age-Standardized Rate	Confidence Interval Lower	Confidence Interval Upper
Interior	16,825	4.9	3.5	3.4	3.5	19,361	5.7	4.2	4.1	4.3	36,206	5.3	3.8	3.8	3.9
Fraser	35,267	4.9	4.3	4.2	4.3	39,897	5.7	5.3	5.3	5.4	75,192	5.3	4.8	4.7	4.8
Vancouver Coastal	24,374	4.6	3.7	3.7	3.8	26,362	5.2	4.5	4.4	4.6	50,769	4.9	4.1	4.1	4.1
Vancouver Island	17,843	5.0	3.5	3.5	3.6	20,012	5.9	4.4	4.3	4.4	37,868	5.5	3.9	3.9	4.0
Northern	6,232	4.5	4.6	4.5	4.7	7,072	4.8	4.9	4.8	5.1	13,311	4.7	4.8	4.7	4.9
Unknown Region	1,385	2.7	3.2	3.1	3.4	1,755	2.4	3.7	3.5	3.9	3,142	2.5	3.4	3.3	3.6

Note: 2003/2004 numbers are not adjusted for incomplete follow-up of the incident case definition.

Table I.4

Estimate of Prevalent Cases and Prevalence Rates of Diabetes, by Health Service Delivery Areas, BC, 2003/2004 (unadjusted)

HSDA	FEMALES					MALES					TOTAL				
	Prevalent Cases	Crude Rate per 100	Confidence Interval Lower	Confidence Interval Upper	Age-Standardized Rate per 100	Prevalent Cases	Crude Rate per 100	Confidence Interval Lower	Confidence Interval Upper	Age-Standardized Rate per 100	Prevalent Cases	Crude Rate per 100	Confidence Interval Lower	Confidence Interval Upper	Age-Standardized Rate per 100
East Kootenay	1,736	4.6	3.4	3.7	3.6	1,837	4.9	3.7	4.0	3.8	3,574	4.7	3.6	3.8	3.7
Kootenay Boundary	1,870	4.8	3.2	3.5	3.3	2,022	5.2	3.7	4.0	3.9	3,894	5.0	3.5	3.7	3.6
Okanagan	8,037	4.9	3.2	3.3	3.3	9,526	6.1	4.1	4.3	4.2	17,574	5.5	3.6	3.8	3.7
Thompson Cariboo Shuswap	5,182	4.9	3.8	4.0	3.9	5,976	5.7	4.3	4.6	4.5	11,164	5.3	4.1	4.2	4.2
Fraser East	6,670	5.2	4.2	4.5	4.3	7,413	5.9	5.1	5.4	5.3	14,097	5.6	4.7	4.9	4.8
Fraser North	12,673	4.6	3.9	4.1	4.0	14,445	5.4	5.1	5.2	5.2	27,126	5.0	4.5	4.6	4.6
Fraser South	15,924	5.1	4.4	4.5	4.4	18,039	5.9	5.4	5.6	5.5	33,969	5.5	4.9	5.0	4.9
Richmond	4,523	4.8	3.9	4.1	4.0	5,088	5.8	5.0	5.3	5.1	9,613	5.3	4.4	4.6	4.5
Vancouver	14,876	5.0	4.0	4.1	4.1	15,503	5.3	4.7	4.8	4.7	30,406	5.1	4.3	4.4	4.4
North Shore/Coast Garibaldi	4,975	3.7	2.8	2.9	2.8	5,771	4.5	3.5	3.7	3.6	10,750	4.1	3.2	3.3	3.2
South Vancouver Island	10,142	4.9	3.4	3.6	3.5	10,655	5.6	4.1	4.3	4.2	20,806	5.3	3.8	3.9	3.8
Central Vancouver Island	6,395	5.1	3.4	3.6	3.5	7,777	6.5	4.4	4.6	4.5	14,176	5.8	3.9	4.0	4.0
North Vancouver Island	1,306	4.9	4.1	4.6	4.3	1,580	5.7	4.7	5.3	5.0	2,886	5.3	4.5	4.9	4.7
Northwest	1,696	4.5	4.4	4.9	4.6	1,994	5.0	4.8	5.3	5.0	3,692	4.7	4.7	5.0	4.8
Northern Interior	3,338	4.7	4.5	4.9	4.7	3,784	5.1	4.9	5.2	5.1	7,124	4.9	4.8	5.0	4.9
Northeast	1,198	3.9	4.1	4.6	4.4	1,294	4.0	4.3	4.8	4.5	2,495	3.9	4.3	4.6	4.4
BC	1,385	2.7	3.1	3.4	3.2	1,755	2.4	3.5	3.9	3.7	3,142	2.5	3.3	3.6	3.4

Note: 2003/2004 numbers are not adjusted for incomplete follow-up of the incident case definition.

Appendix J
Resources for People With Diabetes

Canada

Canadian Diabetes Association

http://www.diabetes.ca

The Canadian Diabetes Association is a major supporter of diabetes research, education, and advocacy in Canada. Their website provides a comprehensive online resource for people with, and affected by, diabetes.

Public Health Agency of Canada

http://www.phac-aspc.gc.ca/ccdpc-cpcmc/diabetes-diabete/english/index.html

This is the diabetes prevention website from the Centre for Chronic Disease Prevention and Control.

Endocrinology and Diabetes Unit (EDU), Children's and Women's Health Centre of British Columbia

http://www.cw.bc.ca/endodiab/

The Endocrinology and Diabetes Unit at the BC Children's Hospital, serves as a diagnostic, treatment, and education centre for children and families affected by diabetes. This website includes resources for children and adults with diabetes.

2003 Canadian Diabetes Association Guidelines

http://www.diabetes.ca/cpg2003/

Detailed clinical practice guidelines for physicians, developed by the Canadian Diabetes Association. These are the current standards of care for diabetes in Canada.

Health Canada – Diabetes

http://www.hc-sc.gc.ca/english/diseases/diabetes.html

Provides basic information on the status of diabetes in Canada, including resources and programs.

Juvenile Diabetes Research Foundation Canada

http://www.jdfc.ca/

This foundation is the largest non-profit, non-governmental funder of diabetes research in Canada. It is an affiliate of Juvenile Diabetes Research Foundation International, a non-profit organization for concerned parents of children with diabetes.

National Aboriginal Diabetes Association

http://www.nada.ca/

Addresses diabetes among Aboriginal Peoples by creating networks and opportunities for individuals, families, and communities within their beliefs, traditions, and values.

British Columbia

BC HealthFile: Diabetes: Getting Started

http://www.bchealthguide.org/healthfiles/hfile70.stm

This publication offers information on eating healthily to help control diabetes.

Dial-a-Dietitian Resources

http://www.dialadietitian.org/nutrition/Diabetes32.html

The Dial-A-Dietitian Website includes a list of diabetes resources. You can also call the Free Nutrition Infoline provided by Dial-a-Dietitian: Toll-free in B.C.: 1-800-667-3438; Greater Vancouver: 604-732-9191.

Chronic Disease Management, BC Ministry of Health

http://www.healthservices.gov.bc.ca/cdm/

The Chronic Disease Management website provides information on all aspects of diabetes care as well as the annual document *A Snapshot of Diabetes Care in British Columbia,* which provides information on the recommended services for diabetic patients.

Appendix K

Health Authorities and Health Service Delivery Areas in BC

Figure K1 Health Authorities and Health Service Delivery Areas in BC

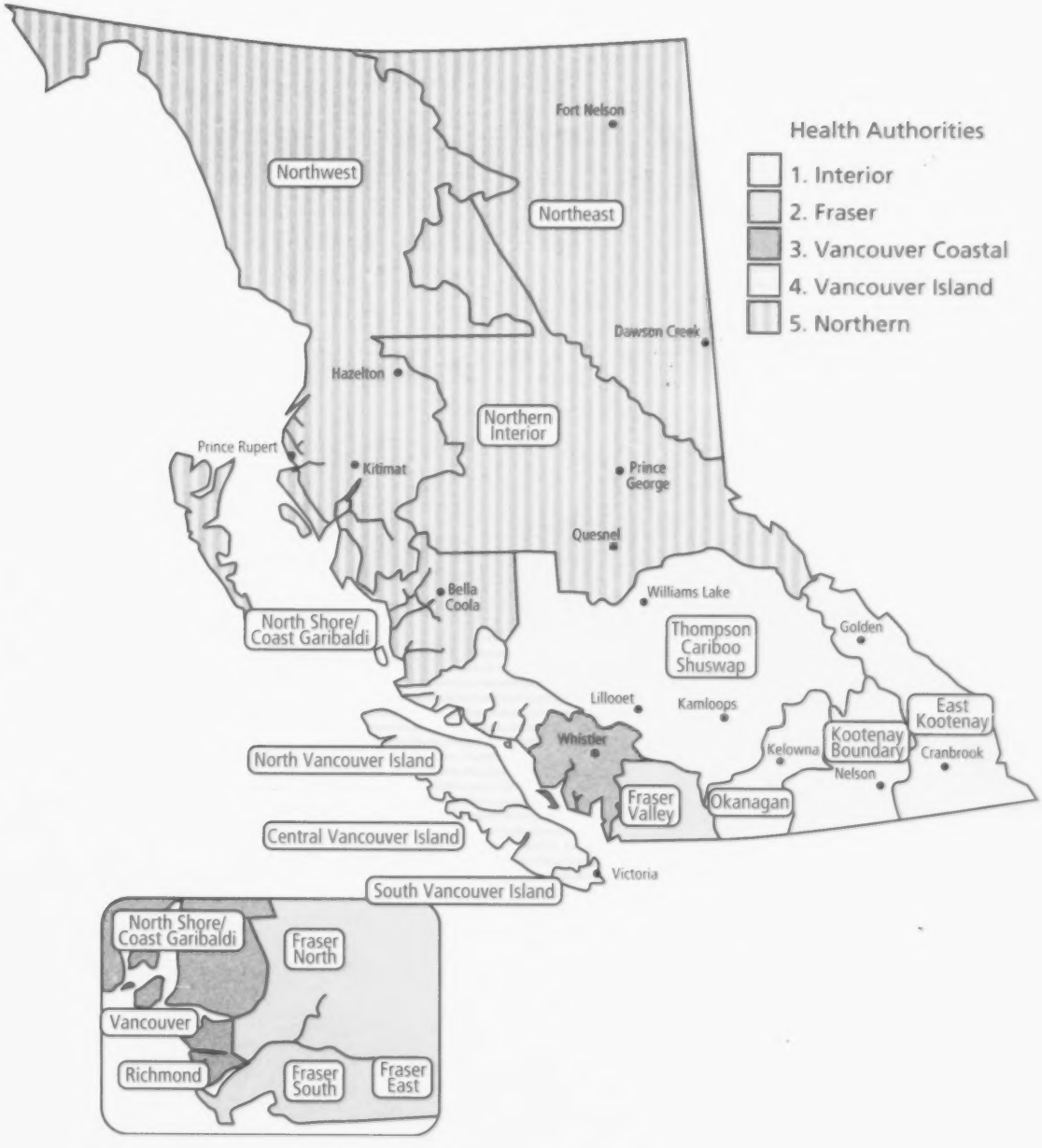
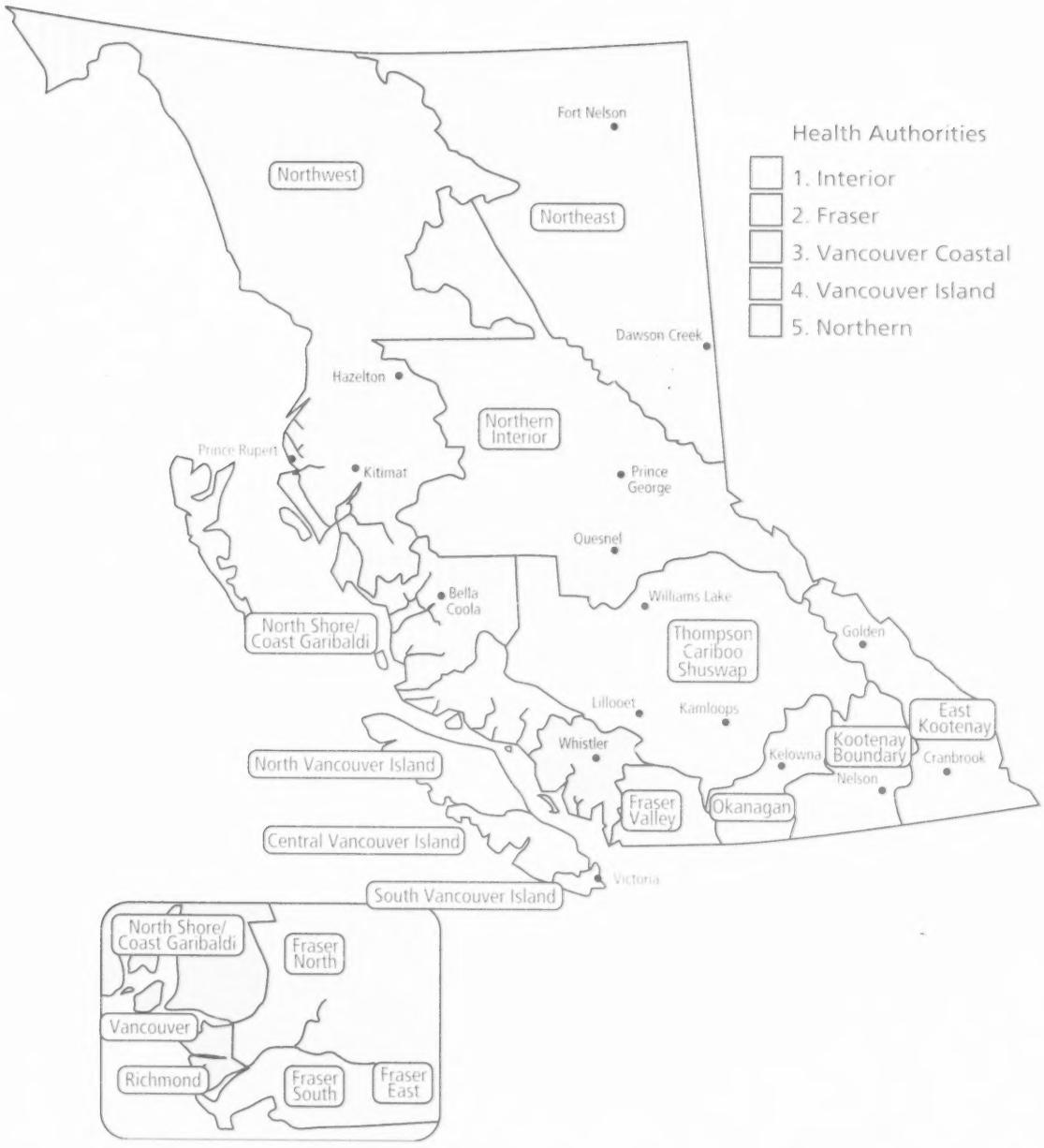


Figure K1 Health Authorities and Health Service Delivery Areas in BC



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